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Philadelphia Convention of the American Street Railway Ass'n. ..Supplement

THE AMERICAN STREET RAILWAY CONVENTION.

The twenty-fourth annual meeting of the American Street Railway Association was held this week at Philadelphia, while the younger bodies and offshoots, representative of the electrical and mechanical engineers, the accountants, the manufacturers and supply men also held their meeting during the same period. From small beginnings a quarter century ago, the street railway convention has grown into one of the very largest of the annual gatherings brought together by a typical and leading American industry, and even a registration of between two and three thousand names does not fully exemplify the magnitude of the occasion. It is seventeen years since the last association met in the city of Franklin. Then the convention was a few hundred strong and did not perceptibly crowd a modest hotel, nor do much to arrest the public attention. This week it has filled every room in the city's largest hostelry to overflowing and swamped all the lodging facilities in the vicinity. The columns of the newspapers have become an exuberant part of the electrical press, and the railway exhibit of apparatus at the Philadelphia Museum has, in extent, interest and beauty, been more than equal to the pretentious displays in the same spacious halls which have been heralded the country over.

Unusual importance has attached to the convention of the past week on account of the formulation of a new constitution for the parent society, attempting to recast the work and membership of the association in a manner that would enable it to keep abreast of the enormous advances in the art and industry, and that while broadening its bases would add also to its dignity, responsibility and influence. This question whether in the prolonged executive committee meetings, the fugitive conversations in the hotel lobby and restaurants, or the animated discussions in the meeting hall, was in reality the predominant one of the week, as it was felt that on its wise settlement depended not alone the welfare of the association, but the very future of the industry itself, if the association were to be its exponent and representative body. Another vital element of interest also made itself apparent during the week in the attention given to fundamental methods of operation, for the association after occupying the streets of all the cities in the Union, has gone out into the highways and byways of the country and made suburb and rural region alike part of its territory. At the present moment the member companies of the association rest definitely on direct-current apparatus and distribution in urban limits, but the newer work outside the city walls points strongly to alternating-current systems, and this, too, seems the outlook for main steam railroads.

Even during the convention a profound sensation was caused by the announcement that the New York, New Haven & Hartford Railroad had placed a contract with one of the great manufacturing companies for no fewer than 25 single-phase electric locomotives, to cost $30,000 apiece. Such a brilliant new departure, like lightning out of a clear sky, developed at once a universal wonder and speculation as to whether the tendency to unification of street railway and steam railway electrification would be helped or otherwise by a change of this character, or whether the urban work would settle down definitely to direct current, while the extra-urban work would go over to the erstwhile rival—the alternating-current—which has already so significantly changed the whole aspect of electric lighting and of power transmission. By many of the "old-timers" who attended the cosy little convention of 1887 it was suggestive of the rate at which electrical history is made

that just as a patent runs out in seventeen years so the art had lived through one whole period of gigantic development, and, in spite of the magnificent creations of the term, and of the tremendous investments it had seen, and the armies of capital and labor it had enlisted, was now ready for revolutionary processes, and the assumption of more onerous tasks than any previously attempted.

The Operative Side of the Electric Railway.

The account given elsewhere of the proceedings of the Philadelphia meeting of the American Railway, Mechanical and Electrical Association show that the papers presented formed as a whole an admirable contribution to the practical side of the electric railway art. In general they cover apparatus and appliances in actual service, and the treatment of the subjects was from the standpoint of men directly connected with he operaing side of the electric railway, and for the particular benefit of men similarly engaged. The discussion of the report on "Controlling Apparatus" brought out the interesting fact that operating engineers would welcome a system of car control for single cars equivalent to the train multiple-unit system of control. That manufacturing companies, in view of this situation and assisted by the operating engineers, will eventually be able to develop such a system cannot be doubted, and indeed much work has already been accomplished in this direction. The old problem of operating compound-wound generators in parallel was presented in a modified form when the paper by Mr. Hile on the "Power Distributing System of the Boston Elevated Railway Company" was being discussed. The distributing system of this company is so arranged that the main bus-bars in the several stations are connected together through feeder wires running into so-called feeder sections common to two or more stations, as noted in our abstract, and it appears that attempts to cause several stations to assist each other in carrying the load had met with varying success.

Experience has shown, as a study of the problem would indicate, that the determining factors are the resistance of the connecting lines, the points at which the loads are applied and the degree of compounding of the generators. With over-compounded generators it is absolutely essential for stability of operation that the drop in voltage across the connecting lines for a certain current be less than the increase in generator voltage due to the passage of this current through the series field coils. In order that the load shall be divided equally between two stations, it is necassary that current be supplied at a feeding point between the two stations. If the load is applied directly at one station and it is desired that another station shall assist in carrying the load, the generators must be adjusted for a drooping-voltage load characteristic. In order to preserve as much as possible the compounding features of the generators, a compromise is found in the use of generators having flat characteristics indirectly joined through feeders. While such a scheme evidently permits the generators to divide the intervening load between them, and is perhaps the best that in practice can be devised, it is evident that a lightly-loaded station will in no wise assist another which is heavily loaded in its immediate neighborhood.

The Theory of Incandescent Lamps.

Dr. Roeber's admirable paper, read at the meeting last week of the Electrochemical Society, summarizes very clearly the physical theory which lies behind the phenomena of luminous radiation. It is only within the last few years that so broad a view has been possible. Given a lamp with a conducting filament which is at all temperatures free from selective radiation, and the ratio between the temperature and the energy radiated becomes fairly simple. Following up this trail a very direct relation appears between the temperature and the wave length of the maximum energy so that, within limits, the color of the light can be determined and also the distribution of energy in the spectrum. A step further and it becomes possible to compute the temperature at which the maximum proportion of the total radiated energy would lie within the visible spectrum—that is, the temperature of maximum illuminative efficiency. Unfortunately, at the point of the chase one gets into a *cul de sac*, for this temperature appears to be about 4,600° C., which is very far out of reach so far as incandescent lamps are concerned. And even if it were attainable the lamp would still be very far from giving the maximum possible efficiency. For while the wave lengths of the visible spectrum lie roughly between 4×10^{-5} and 8×10^{-5} cm, those which are physiologically useful lie in a far more restricted range, say from 4.8×10^{-5} to 6.5×10^{-5} cm., and those outside the limits 5×10^{-5} and 6×10^{-5} cm. are comparatively unimportant.

Hence, as Dr. Roeber points out, what we really want as a radiant is not the theoretical body without selective power, but a body which shall, without waste of energy, deliver a radiation entirely within these narrower limits. A nearly monochromatic light, which no heated filament comes anywhere near to giving, is the real desideratum, so far as mere efficiency is concerned. The only light which approximates such quality is that of the firefly, which would seem to bring the ideal source of illumination within the realm of physiological rather than physical chemistry. To meet fully the physical requirements of the case, color must be taken into consideration, and this requirement calls not for one monochromatic source, but for all three primary colors. If one could to-day steal the firefly's secret he would have a light that for aesthetic reasons would be almost unsalable. He would have to improve upon his booty to make it really valuable. In all commercial work it is physiological light, not physical radiation, which is important, and hence all the attempts to determine a mechanical equivalent of light rest on a somewhat shaky foundation, interesting as they are. The figures thus far obtained range from 0.2 to 0.1 watt per candle. This region has been reached by both the instantaneous value obtained from an incandescent lamp burned out on the instant, and by an arc struck between electrodes of composition similar to Welsbach mantles.

It is quite evident, however, that in both these cases there was considerable energy outside the visible spectrum and still more outside the useful spectrum, so that with a selective radiating body it should be possible to get far below these limits. And if such a selective radiant is ever obtained, it need not necessarily be worked at an enormously high temperature. This is the *rationale* of the attempt to use gaseous radiants of which the radiation is discontinuous, with the accompanying high efficiencies that have been obtained from the mercury arc and from Geissler tubes. The trouble met at this point is the extreme difficulty of getting a high enough intrinsic brilliancy from the latter and a useful color from the former. Hence little has been accomplished. The new incandescent lamps of tantalum, osmium and graphitized carbon, are reversions to the region of enormous temperatures, and hence must be regarded as strictly limited in efficiency, although that has gone before. The Nernst lamp shows similar limitations. By using these newer lamps, however, one can reach an economical life of much greater efficiency than heretofore. We are pleased to see Dr. Roeber come strongly out for the mean spherical measurement of incandescents. It is the only one which defines fairly the total light available. When there was furious competition between electricity and gas, there was commercial reason for adopting the measure-

ment comparable with one's rival, but to-day electricity has the field very much in its grasp and would really gain by adopting a rating that, while strictly scientific, is also one by which it would benefit rather than suffer in comparison.

SURGES ON TRANSMISSION LINES.

The theory of surges on transmission lines has been fairly developed from an engineering standpoint and some observations of the magnitude of these surges have been made on artificial transmission lines. The transactions of the Societé Internationale des Electriciens for the current year contain a paper by M. Ch. David upon some experiments conducted on actual transmission lines operated at nine kilovolts pressure, under conditions favorable to the production of surges. The circuit experimented upon formed a loop having a perimeter of 40 miles. The lines were overhead, with the exception of 8 miles of underground cable about midway along the loop. The capacity of the underground cable would tend to aid the development of surges. On the other hand, there would be reflections set up at the junctions of the cable with the overhead wires, which would tend to diminish the surges. There were also a few unloaded transformers left connected with the circuit. Consequently the circuit was somewhat special in its character, but the surges observed upon it would, at least, be illustrative. The three-phase alternator employed at the sending end of the circuit generated a charging current of about 5 amperes at 9 kilovolts. This changing current was made and broken by a switch at the sending end of the line.

The voltage at the receiving end of the line was observed by means of an oscillograph, when the switch at the sending end was opened and closed. A number of these oscillographs are reproduced with the paper. They show that there is always an oscillation or surge produced on the lines when the latter are connected to an alternator, except when the connection happens to be made at the or near the zero of impressed e.m.f. That is to say, if the lines are switched on to the bus-bars near the instant at which the e.m.f. of these bars is changing sign, there will be no oscillation produced. If, on the contrary, the switching is made near the peak of an e.m.f. wave, there will be a surge of e.m.f. and current set up in the lines. Under some conditions the surge e.m.f. reflected from the distant end of the circuit may add itself negatively to the impressed e.m.f. and actually reduce for the moment the magnitude of that e.m.f.; but it usually happens that the reflected surge wave adds on to the impressed wave, and so augments the pressure on the lines for the time being. According to theory, the maximum value of the surge e.m.f. is equal to the impressed e.m.f. which produced the surge. Consequently, the maximum augmentation which can occur when the reflected surge add on to the impressed e.m.f. is 100 per cent. In practice, the augmentation must be less than 100 per cent, owing to the attenuation of the surge during its passage to and from the distant end of the line. Moreover, it will be only rarely that the switching occurs at the full crest of the alternator e.m.f. wave; so that even if there were no attenuation in the surge during reflection, it would only be in rare instances that the maximum normal voltage on the line would actually double. In the course of a very large number of switchings the average percentage of the surge increase of the maximum normal voltage would be 63 per cent, with no attenuation of the surge. With attenuation present the average would be considerably less than 63 per cent. In the course of 16 oscillographic records reported on this particular circuit, the average percentage of rise was slightly less than 40 per cent, the maximum being 67, and the minimum 8 per cent.

The oscillograms, which are very interesting, show that the surge e.m.f. had a natural frequency about seven times greater than that of the impressed e.m.f., as might be inferred from the inductance and capacity of the line; so that while the alternator had a frequency of 25 cycles per second, the line had a frequency of 175. The phase of the surge at one end of the line was opposite to the phase at the other end. The actual e.m.f. at any instant was the sum of the impressed and surge e.m.f's there existing. There was not much difference between the maxima attained at the sending and receiving ends. The surge was evidently subject to great attenuation and was practically damped out in about six oscillations. Consequently, in about the period of one complete cycle of the alternator the surging had practically dwindled to zero, and the charging regime had become steady. In opening the switch, or removing the lines from the alternator bus-bars, the voltage on the line does not instantly vanish, but undergoes a surge, partly due to the sudden removal of voltage and partly to the interruption of the charging current. The resultant surge has a period longer than that of the alternator and subject to so much attenuation that it is practically damped out in a single oscillation. As there is no impressed e.m.f. at work upon which the surge e.m.f. can be superimposed, the voltage on the line at breaking was always much less than the normal voltage. This was, however, only because the charging current was about 5 amperes. If the switch had interrupted a full-load working current, or more particularly an overload current due to short-circuit, the voltage in the surge might greatly exceed the normal impressed voltage.

As the result of these valuable oscillograph experiments, the theoretical deduction is confirmed that when a transmission line is suddenly switched on to the generator bus-bars, there will be a few surges of voltage which may momentarily raise the voltage on the line by somewhat less than 100 per cent, perhaps at most, 70 per cent. There is no danger of taking such a line off the bars when the line is idle, because the charging current to be interrupted is so relatively feeble. There is, however, a danger of overvoltage if the switch opens a load current, or particularly, if it opens an overload current. The oscillograms taken on the unloaded line with an oil-switch did not differ appreciably from those obtained with an air-switch. From a practical standpoint, it is unlikely that a cable in good condition would be damaged by a few momentary overvoltages of 70 per cent, such as are apt to occur in switching on. Nevertheless, when very high voltages are in use and the factor of safety of the cable is low, it is desirable that the switching-in should only occur at or near the zero of voltage when the e.m.f. is changing sign. This might be arranged for automatically, by exciting an alternating electromagnet from the bus-bars in such a manner that this electromagnet would bring the switch contacts together only at the zero of the voltage waves. Some engineers actually employ a separate set of bus-bars for slowly raising the voltage of a high-pressure transmission cable prior to connecting this with the bus-bars, in order to avoid the surge of closing. It would seem that there is no danger to be apprehended from switching an unloaded cable off the high-tension bus-bars; but that there is considerable danger in unswitching when there is an overload of current through the cable. It is important in such cases that the unswitching should occur at or near the zero of current. This might be accomplished automatically by causing the overload circuit-breaker to produce a pull on the switch lever, which pull would be opposed by alternating electromagnets in the main circuit. The latter would lose their excitation at the zero points of current and thus allow the switch to open near the proper instant. The paper referred to contains a number of other experiments, and the copies of the oscillographs printed therewith well deserve detailed study by electrical engineers.

Single-Phase Locomotives for New York, New Haven & Hartford Railroad Company.

Perhaps the most interesting event at the convention of the American Street Railway Association, held in Philadelphia the present week, was an announcement made by Mr. C. F. Scott in a paper read at one of the meetings (an abstract of which is printed elsewhere in this issue) that the New York, New Haven & Hartford Railroad Company had decided upon the use of the Westinghouse single-phase railway system. Following this it was made public that the railroad company had awarded a contract to the Westinghouse Company for 25 locomotives for high-speed passenger service, the price being $30,000 each.

The locomotives will each weigh, approximately, 78 tons, and will be capable of maintaining a schedule speed of 26 miles per hour in local service, hauling a 200-ton train making stops every 2.2 miles, and reaching a maximum speed of about 45 per hour between stations. In express service a speed of from 60 to 70 miles per hour can be maintained with a train weighing 250 tons. To handle heavier trains two or more locomotives will be coupled together and controlled from the forward cab by the multiple-unit control system.

The motors will be the Westinghouse single-phase commutating type, which, as is well known, can also be used with direct current. The locomotives will thus be able to operate over the direct-current section now being installed by the New York Central Railroad Company, the New York, New Haven & Hartford utilizing the tracks of that company between Woodlawn and the Grand Central Depot in New York. For a time the service will be confined to this section, so that it was with a view to the future rather than to present requirements that the alternating-current system was adopted.

Each locomotive will be equipped with four gearless motors and with the unit-switch system of multiple control. The motors will be permanently connected two in series; on direct current the pairs of motors will be operated in series parallel and on alternating current by voltage control. The motors will be spring supported and connected by a flexible drive in such a way that all dead weight will be taken off the axles. On direct current each motor will be capable of developing an output of 400 hp.

Report on Central Station Statistics.

The Bureau of the Census has just published a report on central electric light and power stations for the year ending June 30, 1902, prepared under the supervision of Mr. W. M. Steuart, chief statistician for manufactures. It is the third of a series of reports on the operation and utilization of electric current. In addition to the text, which was prepared by Mr. Thomas Commerford Martin, of New York City, expert special agent, there are elaborate tables and an interesting series of illustrations.

The chapters of text discuss, respectively, the scope and method of the investigation, financial operations, employes, salaries and wages, physical equipment, output of stations, franchises and the history and development of electric lighting.

The statistics do not include isolated electric light and power plants installed in manufacturing establishments, hotels, office buildings, etc., for the purpose of furnishing the light and power primarily for the use of the individuals, firms or corporations operating such establishments.

For convenience in study the various electric stations have been divided into two grand classes: First, those operated by individuals or corporations, and second, those operated under municipal control. Each of these classes is subdivided into, first, those doing a purely electric business, and second, those operated in connection with other industries. The latter are designated composite stations.

Further subdivisions have been made, one being based upon the population of the place in which the station is located and the other upon the horse-power capacity of the generating apparatus of the station.

The growth of this industry is shown by the following figures: From 8 stations beginning operation in 1881 the number rose to 100 in 1886, to 208 in 1889, and to 247 in 1892. During the following years of depression the number of new stations fell; but in 1895, though a time of financial stringency, it again rose to 239. In 1898 it reached 277, or more than the number beginning operation in the entire period from 1881 to 1886, inclusive. The number for 1901 was 250, and for five months of 1902 it was 146. In the twenty years from 1881 to 1901, inclusive, an average of 165 private and municipal stations have begun operation each year. The spread of the agitation for municipal ownership of public service enterprises is illustrated in a somewhat striking manner. Of the 815 municipal stations enumerated, only 68 had been installed up to 1889. In that year 40 were introduced, and in 1895 the number of new stations reached 73, increasing in 1898 to 82. The returns for 1902 indicate that the ratio was fully maintained in the census year.

In 1902 there were in the United States 3,620 central electric stations, with a cost of construction and equipment of $504,740,352. Employed were 6,996 salaried officials and clerks with salaries amounting to $5,663,580; and 23,330 wage-earners with wages amounting to $14,983,112. The gross income was $85,700,605, comprising $84,186,605 from sale of current and $1,514,000 from other sources. Total expenses were $68,081,375. The total output of stations for the year, in kilowatt-hours, was $2,507,051,115. The number of arc lamps was 385,698 and of incandescent lamps 18,194,044.

Private stations form by far the largest portion of the industry, constituting 77.5 per cent of the total number of stations in operation during 1902. Their income from sale of current was $78,735,500, or 91.9 per cent of gross income, the expenses of operation 92.3 per cent of the total, while they gave employment to 89.4 per cent of the total number of wage-earners engaged in the industry and paid 90.5 per cent of the total amount of annual wages. The primary power plant equipment of these stations formed 91.3 per cent of the total horse-power of all stations while the generating equipment formed 90.6 per cent of the total horse-power of all dynamos. The kilowatt-hour output of private stations formed 92.2 per cent of the total, and the arc lamps in such stations formed 86.8 per cent of the total number wired for operation.

The comparison of the income of the two classes of stations is not a fair indication of their earning capacity, because of the gross income reported for municipal stations. Of this gross income $6,836,856 resulted from the sale of current and included income from public service which was necessarily largely, if not wholly, a matter of estimation.

The private stations employed 20,863 wage-earners, who were paid $13,560,771, and 6,046 salaried officials and clerks with salaries amounting to $5,206,199, while the municipal stations employed 2,467 wage-earners, who were paid wages amounting to $1,422,341, and 950 salaried officials and clerks, who were paid $457,381.

The cost of construction and equipment of the municipal stations was only 4.4 per cent; their income from sale of current, 8.1 per cent; their expenses 7.7 per cent; and the horse-power capacity of their power and generating plants 8.7 and 9.4 per cent, respectively. The output of such stations was 7.8 per cent of the total kilowatt-hours produced by all the stations, while their arc lamps were 13.2 per cent and their incandescent lamps 8.7 per cent of all the lamps reported for the country.

In addition to controlling practically the entire industry, the average private station is much larger than the average municipal station. Considering the total of 2,805 private stations, it appears that the average total expense per year per station was $22,401, as compared with $6,437 for municipal stations. The private stations gave employment on the average to 7.4 wage-earners, while the municipal stations gave employment to 3. The average private stations reported 823,938 kilowatt-hours per year, as compared with 240,373 for the municipal stations.

It is found that 732 municipal stations operated in that number of communities in which there was no competitive private service. It would appear that in all probability a great many if not all of these places would have gone without electric lighting had the supply been left to private enterprise seeking a return upon its investment. The population served by these stations was 2,052,485, an average of a little over 2,800 per station, and towns of this size rarely offer inducements to private capital, regarded from the per capita basis of consumption of current. These stations also represent a total cost of construction and equipment of $15,369,382, or about $21,000 per station, whereas the average cost of construction and equipment for the 3,620 central stations of all classes was slightly short of $140,000. The largest average population per community is shown for Massachusetts, having 17 stations, with an aggregate population of 151,407, or an average of 88,906. The smallest population per community is

shown for Colorado, with two municipal stations supplying 1,402 people, or an average of 701 for each station. An average of 5 persons to a family or house would give barely 140 houses.

The largest number of stations was in Illinois, followed by Pennsylvania, New York, Ohio, Michigan, Indiana, Iowa and Wisconsin in the order named. No other State reached the 150 mark. The New England States were well supplied with stations. Massachusetts reported the largest number, then came Maine, Vermont, New Hampshire and Connecticut. Among the Southern States Texas led, with Kentucky, Tennessee and Georgia following. Of the Western States, California reported the largest number of stations, Colorado, Washington, Oregon and Montana being next in order. Of the 1,892 places reported at the Twelfth Census as having a population of 2,500 and over, 1,511 had one or more central electric lighting stations. Of the places with a smaller population, 1,960 had similar stations.

A number of companies supply areas of many square miles in which are located scores of cities, towns, incorporated villages and mere hamlets, all enjoying the benefits of electricity and constituting a source of income for the enterprise. The extreme limit of such work at the time of this report was marked by the long-distance power transmission on the Pacific coast, where current from the Sierras was actually delivered for general consumption in San Francisco and Sausalito, and was also distributed from the same plants over lines which ramify into half the counties of the State of California. The whole aspect of central station current supply in its relation to population has in reality been utterly changed by the development of polyphase power transmission plants. There are at least a thousand such plants, with lines frequently 15 or 20 miles long, in many cases 40 or 50 miles, often 60 or 90 miles, and sometimes even 150 or 200 miles.

These transmission enterprises are peculiarly typical of the far Western States, but are by no means concentrated there, being scattered all over the Union.

The total capital stock and funded debt authorized amounted to $743,296,266, but the amount issued was considerably less, being $627,515,875. Of the total amount authorized, $435,178,372, or 58.5 per cent, was capital stock, and $308,117,894, or 41.5 per cent, was funded debt. Of the total authorized capital stock, $372,951,952, or 85.7 per cent, had been issued at the end of the year covered by the report. Of the capital stock issued $23,871,671, or 6.4 per cent, was preferred stock and $349,080,281, or 93.6 per cent, was listed as common stock.

Private stations expended $40,050,613 and municipal plants $1,741,834 in construction and equipment during the year covered by the report. The total for private stations from their origin until 1902 was $482,719,879, giving an average outlay of $328 per horse-power of dynamo capacity. It is interesting to compare these figures with those for municipal stations, which show a cost for construction and equipment of $22,020,473, and an average of about $145 per horse-power of generating capacity; it is not safe to accept this average as a basis of comparison, on account of the wide variations revealed in the different States, which range from $114 in Ohio to $844 in the State of Washington.

Although the practice of supplying current for motive power and other uses had grown rapidly, the supplying of current for light was still preponderatingly the business of both private and municipal stations. Of the total income $70,138,147, or 81.8 per cent, was directly derivable from lighting. The private stations obtained 80.5 per cent and the municipal stations 96.9 per cent of their income from this source. This income from sale of current for lighting purposes was derived from 385,698 arc lamps and 18,194,044 incandescent lamps. The average income per lamp for arc lights in private stations and used for commercial or other private lighting was $48.88; used for public lighting, $83.20. In municipal stations, for commercial or other private lighting, it was $41.46; for public lighting, $69.98. The incandescent lamps in private stations in commercial use earned an average income of $2.40 per lamp; in public service, $6.06. In municipal stations these lamps earned $1.92 in commercial service and $5.93 in public service.

The total expenses for private and municipal stations were $68,081,375. Of this $20,646,692 was for salaries and wages, $22,915,932 for supplies, materials and fuel, $11,895,206 for rents, taxes, insurance and miscellaneous expenses, and $12,623,545 for interest on bonds.

Physical equipment is considered under the three heads: Power and generating equipment, line construction and service line equipment. The power plant equipment showed 5,930 steam engines with 1,379,941 hp, and 1,390 water wheels with 438,472 hp; and the generating plant equipment 3,823 direct-current, constant-voltage dynamos with 442,446 hp; 3,589 direct-current, constant-amperage dynamos with 195,531 hp, and 5,122 alternating and polyphase-current dynamos with 987,003 hp. The line construction had 107,263 miles of mains and 17,880 miles of feeders For the service line equipment, meters, lamps and motors are the important items. There were 582,689 meters, 575,004 of these were mechanical and 7,685 chemical. The aggregate of arc lamps of all classes was 385,698, of which 334993, or 86.8 per cent, were operated from private stations and 50,795, or 13.2 per cent, from municipal stations. In addition to these 385,698 arc lamps connected to the circuits of central stations, the street railways operating electric lighting stations reported 33,863 arcs, making the total for the United States 419,561.

The average output in kw-hours per day for all stations was 6,960,783, making a total for the year of 2,507,051,115. For private stations the output was 2,311,146,676 kw-hours, and for municipal stations 195,904,439. Among the private stations the totals for New York are at the head of the list; among the municipal, Illinois.

Colorado Electric Light, Power and Railway Association.

The third annual meeting of the Colorado Electric Light, Power & Railway Association, held at Glenwood Springs, Colorado, Sept. 18 to 20, was well attended, about two-thirds of the membership being represented at the convention. An important action taken at the meeting was the adoption of an amendment to the Constitution whereby eligibility to membership in the association was extended to residents of Utah, Wyoming, Idaho, Nevada, New Mexico and Arizona. Members from these states will be given full privilege under the active membership clause. Following are the officers of the association elected for the ensuing year:

President, Mr. F. W. Frueauff, Denver; vice-president, Mr. William Mayher, Greeley; secretary and treasurer, Mr. George B. Tripp, Colorado Springs. Messrs. J. Beeler, of Denver, and J. F. Vail, of Pueblo, were elected additional members of the Executive Committee. The members of the Finance Committee are Messrs. D. F. Harper, Trinidad; P. R. Stout, Central City, and H. M. Gilbert, Pueblo. The Membership Committee is composed of Messrs. J. J. Cooper, Denver; J. E. Blackall, Denver, and B. K. Sweeney, Denver. The five members of the Advisory Committee are Messrs. William T. Wallace, Canon City; E. J. Temple, Boulder; R. L. Goodale, Colorado Springs; A. M. Ballou, Denver, and W. J. Barker, Denver.

Five papers were presented at the meeting as follows: "Notes on an Up-to-Date Sub-Station," by Mr. A. M. Ballou; "A New High Candle Power Incandescent Lamp," by Mr. C. B. Mahaffey; "The Application of Electric Power to Gold Dredging," by Mr. J. F. Dostal; "Isolated Plants," by Mr. H. L. Wolfenden; "Getting New Business," by Mr. R. L. Goodale; "The Mercury Arc Rectifier," by Mr. G. N. Robinson. A feature of the convention was the "Question Box," which was a printed programme comprising 66 questions on the subjects of management, boilers and engines, lightning arresters, pole lines, meters and miscellaneous.

Officers of the American Railway, Mechanical and Electrical Association.

At the conclusion of its meeting in Philadelphia on September 26, the American Railway, Mechanical and Electrical Association, elected the following officers: President, Mr. H. H. Adams, superintendent of shops of the United Railway & Electric Company, Baltimore; first vice-president, Mr. F. G. Simmons, superintendent of construction and maintenance of way of the Milwaukee Electric Railway & Light Company; second vice-president, Mr. J. S. Doyle, master mechanic of Interborough Rapid Transit Company, New York; third vice-president, Mr. Paul Winsor, Boston Elevated Railway, Boston. The executive committee elected is as follows: Messrs. W. S. Twining, Philadelphia; F. N. Bushnell, Providence; W. B. Reed, New York; and A. D. Campbell, Seattle. Mr. S. Walter Mower, Detroit, was re-elected secretary and treasurer.

September Meeting of the A. I. E. E.

The 199th meeting of the American Institute of Electrical Engineers was held September 22 in the assembly room of the New York Edison Company, at 44 West Twenty-seventh Street, New York. The retiring president, J. W. Lieb, Jr., called the meeting to order and introduced the entering president, Dr. Schuyler Skaats Wheeler, prefacing his introduction by the remark that presidents come and presidents go, but the Institute goes on forever. President Wheeler, after a few well-chosen words of appreciation of the honor conferred upon him, gave the floor to Mr. Lieb, who on the part of the New York Edison Company, welcomed the Institute to the assembly room, which was placed at the disposal of the Institute for its meetings until the Engineering Building may be completed. This room, which is now being placed in service for the first time, is well arranged for the purposes of the Institute. The seating capacity is adequate, blackboard facilities are provided and provision is made for a projection lantern when occasion may require. The secretary announced that 32 associates had been elected at the last meeting of the Board of Directors. Mr. C. O. Mailloux was elected a Manager by the Board of Directors to fill the vacancy in that grade due to the election of Dr. Wheeler to the presidency.

FLUX IN INDUCTION MOTOR.

The first paper presented was that of Prof. A. S. Langsdorf, entitled "Air-Gap Flux in Induction Motors." The paper, which is largely mathematical in character, deals with the law of the variation in magnitude of the synchronously rotating flux in polyphase induction motors. The author states that it is common practice in determining its mean value to consider the flux a maximum (in the case of three-phase motors) when the three currents are, respectively, $-\frac{1}{2}I$, I, $-\frac{1}{2}I$, where I is the maximum current per phase, and a minimum when the currents are

$$\frac{\sqrt{3}}{2} I, O \text{ and } \frac{-\sqrt{3}}{2} I;$$

the mean of these two values being then considered as the average for the cycle. This method is, of course, only approximate. The author deduces equations which tend to show that the actual average is not only greater than the value obtained as above, but it may even exceed the above assumed maximum. Four distinct cases are considered: Three-phase motors with even and with odd number of slots per pole per phase and two-phase motors with even and with odd number of slots per pole per phase. On the assumption that the reluctance of the teeth and core is negligible in comparison with that of the air-gap, and that the currents in the separate phase windings follow a sine curve of time value, the value of the flux and its distribution are determined by means of magnetomotive force equations. It is shown that the actual flux can be considered as made up of two components: one a flux of uniform value, the average flux rotating synchronously; and the other a flux consisting mainly of one of sextuple frequency in the case of three-phase motors, and of quadruple frequency in the case of two-phase motors.

In discussing the paper, Dr. A. S. McAllister remarked that the author had neglected to consider the modifying effect of the secondary current. When the secondary circuit is closed, and especially with a squirrel-cage secondary winding, the synchronously revolving magnetism is of constant strength, the combined magnetomotive forces of the primary and secondary currents producing this result. The effect of neglecting the presence of the secondary current will be appreciated if the method of analysis proposed be applied to a single-phase motor. The resultant equations would indicate a field magnetism unidirectional in space and alternating in value, while in reality the magnetism of a single-phase motor at full speed revolves synchronously and is of practically constant strength. The conclusions as to the magnitude of the fluctuations in the magnetism would apply to a polyphase motor, devoid of hysterisis, when operated with the secondary on open circuit, as implied in the original assumptions upon which the equations are based.

Mr. B. A. Behrend stated that the paper indicates an excellent power of analysis, and it is useful in presenting a convenient method for dealing with electrical problems. It is to be regretted, however, that all of the factors entering into the present problem have not been considered, for the results as obtained are not applicable to a commercial induction motor. It is improper to assume that the resultant transformed equations express conditions other than those taken into consideration in forming the original equations. The actual distribution of flux around the air-gap of the motor is materially modified by the mechanical dimensions, and is essentially different from that assumed.

Mr. H. Pikler said that the equations given in the paper are quite simple and permit of easy interpretation. They are based on the assumption of sinusoidal exciting current, while in reality the current is always distorted, on account of the cyclic change in permeability of the magnetic material. The practical application of the author's conclusions to machines in use would, therefore, not be attended with satisfactory results.

ENCLOSED FUSES.

Upon the conclusion of the discussion on Prof. Langsdorf's paper, Mr. H. O. Lacount presented his paper entitled "Standardization of Enclosed Fuses." The paper is divided into four parts, as follows: 1 The necessity of standardizing enclosed fuses. 2 The work of standardizing such fuses. 3 The results of this work, which is contained in the specifications for National Electric Code standard enclosed fuses. 4. The test of enclosed fuses designed to comply with the specifications.

As indicated by its divisions, a large portion of the paper deals with the history of enclosed fuses and shows the methods adopted to obtain the opinion as to requirements of all parties concerned in the manufacture and use of fuses. After reviewing the work of the standardization committees, note is made of some of the main features of the approved standard fuses.

The terminals chosen are of the spring-clip and knife-blade types, which are believed to possess as many of the advantages of the Edison plug and as few of the disadvantages of the screw-and-washer terminals, with respect to wrong fusing as could be obtained and still retain other desirable features. The dimensions for the fuses finally chosen are not those of an entire line of any one of the several manufacturers. The new dimensions, however, are not radically different from those of fuses that have been in use for several years.

The previous specifications of the underwriters require that the fuses be marked with 80 per cent of the maximum current they could carry continuously. While this rule was retained for the line fuses, it was slightly modified in the specifications for the standard enclosed fuse, which require that the fuse must carry 10 per cent more current than that for which it is rated, and must melt with 15 per cent current above its rating. The melting point of the fuse is, therefore, at an overload of between 10 and 15 per cent. The 25 per cent overload necessary to melt a link fuse is thus reduced to from 10 to 15 per cent for the standard enclosed fuse. This smaller margin between the rating and the maximum carrying capacity was considered sufficient, as it was claimed by manufacturers that the enclosed fuse could be rated more accurately than the link fuse, and possibly would be less affected by surroundings, although accurate tests have not yet been made regarding the temperature rise, it is believed that the present approved fuses will meet this requirement satisfactorily.

The paper outlines the result of 11,000 tests on fuses. The failures noted during the tests might be divided into two classes: first, failures in which the circuit was opened properly, but the fuse tubes burst or the end caps or ferrules blew off and second, failures in which the arc held either through or around the fuse. While both classes of failures were rated "poor," the second class is, of course, by far the more dangerous. In one of the worst failures the arc held inside the tube until the emergency switch was opened; in the meantime flame and melted metal were thrown in a continual stream from both ends of the fuse a distance of, say, 20 ft. and a volume of flame and gas or smoke was discharged upward through the side of the tube at least 25 or 30 ft. Lest it might be thought that these failures were frequent, it should be stated that the reverse was true. Such failures clearly indicated defects, which in later tests of improved samples under practically the same conditions were found to have been removed.

The indicator is considered in the trade as an essential part of a commercially successful enclosed fuse. Although the indicators are not mentioned in the specifications, a record of their performance was kept throughout the tests, and it may be of interest to know that, while the majority operated as intended, some of them failed to give the proper indication.

As a rule it has been found that if the fuses meet the specifications

regarding the 10 per cent and 25 per cent overloads, they require a somewhat longer time to melt than given in the specifications. Manufacturers are still confident that the "blowing" time can be brought within the limits specified, and are at work on this feature which was not considered of sufficient importance, however, to prevent approval of the fuses at present. It is believed that the enclosed fuses that had been approved and included in the List of Approved Electrical Fittings, published by the National Board of Fire Underwriters and the Associated Factory Mutual Fire Insurance Companies, are safe for general use. Accidents will occur, and so also will defective fuses be found now and then, but the danger from this cause should be small.

The discussion of the paper was opened by Mr. L. W. Downes, who, as a manufacturer, expressed his entire sympathy with the work of the standardization committee. Standardization eliminates special orders which, although not desirable, cannot ordinarily be refused. The effectiveness of the work of the committee may be learned from the fact that no complaints have been received concerning National Code Standard fuses. The screw clamps used with fuses might, however, be improved upon. The only practical form is the one in which the terminal is positively bolted to the contact. In regard to the knife-blade terminals, it is to be noted that it is extremely difficult to make blades to the exact thickness, a variation of .002 in. not being uncommon. This fact must be considered in attempting to make the fuses interchangeable. In commenting upon the tests to which fuses are subjected Mr. Downes remarked that fuses which opened properly when the generator capacity was, say, 5,000 kw, would frequently fail entirely to prevent an arc when the generator capacity was increased to 10,000 kw. It has been found that the resistance in circuit has much to do with the operation of fuses. The opening of the fuse depends upon the vaporization of the material, and upon the rapidity of the vaporization process, which rapidity depends upon the value of the current. When the current is excessive the vapor pressure around the fuse may be enormous and cause a destructive explosion. A vapor pressure as high as 900 or 1,100 pounds per sq. in. has been observed with 400-amp. fuses.

Prof. W. L. Puffer explained that when a fuse opened under condition of short-circuit, the supply generator being of large capacity, there frequently occurs a certain spark-coil action which causes the voltage to rise much above normal value. On a certain 50-amp. fuse which was blown by 5,000 amp., the voltage of the compound-wound direct-current generator first decreased to 75 per cent of normal and then quickly increased to 200 per cent, the whole action taking place within a small fraction of a second.

Mr. H. G. Stott stated that great difficulty had been experienced in obtaining a suitable fuse for the contact shoes used upon the third-rail systems. When the fuse is subjected to a short-circuit many thousands of kilowatts are available for causing the explosion at the fuse. The great permeability of the rails causes the heavy current to produce around itself a strong magnetic field which when the fuse is blown tends to decrease rapidly to zero value and thereby to generate in the conductor an e.m.f. in a direction to maintain the current. Observations on the New York railways have shown that this excess e.m.f. may amount to 100 per cent of the normal voltage, thus subjecting the fuse to extremely severe conditions. It is imperative that for such service the fuses be given very liberal dimensions. It does not appear to be desirable, however, to require that all fuses of a similar capacity should be designed for such service, and doubtless the fuses should be designed with special reference to the uses to which they will be put.

Mr. Jos. Sachs expressed his approval of the standardization work which had been done and said he believed that all of the recommendations of the committees were good. He thought, however, that there are cases where a "screw-driver" type of fuse terminal is preferable to a "screw-driverless" type, and that both types should be approved. Although he had been one of the first to use indicators with fuses, and he yet believed in them, experience had shown that there are many installations where non-indicator fuses are better than indicator fuses. In regard to the heating of fuse terminals, it is to be noted that lack of proper contact, such as may occur when the knife-blade fails to fit its jaws, may cause a large increase in temperature locally at the terminals. In measuring the temperature at the terminals it is essential that the thermometer be placed immediately in contact with the metal, because heat is quickly transferred from one part to another of the copper.

Bethlehem Meeting of the American Electrochemical Society.

In our last issue we gave an account of the proceedings of the first two days of the eighth general meeting of the American Electrochemical Society, held in Bethlehem, from September 18 to 20.

At the banquet on Tuesday night the president, Dr. W. D. Bancroft, announced that the next meeting will be held in Ithaca, N. Y., probably early in May, and arrangements are already being made to provide for an excellent program of papers. The board of directors of the society has decided to use some of its funds to encourage important research work. The society will hold in future only one yearly meeting, although a second meeting may be held in conjunction with one of the other large national engineering societies.

INSULATING PAINTS.

In our last issue we noticed briefly the interesting paper which was presented on Tuesday morning by Dr. Maximilian Toch. We refer to it again, since the industry of insulating paints is a new industry for which electric traction is responsible. An old steel bridge over which a new trolley line passes soon shows the corrosion of the steel and this deterioration is called electrolysis. A peculiar point is that in all cases the greatest corrosion was found on the steel connected to the minor side (cathode).

The subject is a very broad one. Insulating paints which will do under one condition will not do under other conditions. Thus materials which may be good for a tunnel, and which must withstand moisture, may prove useless in sunshine. The speaker gave a brief review of the chemistry of the subject and remarked that his researches have shown how to predict in a general way what a paint will do from the way in which it is made up.

For cross arm paints a very high resistance is not as essential as that it will withstand the weather, and a liquid medium which sucks into the pores of the wood is better than one which dries by oxidation and forms a film which peals.

Third rails are subject to so much variation and oxidation that often they must be replaced even sooner than the running rails. The web of the rail can be protected with a paint which will resist corrosion and short-circuiting. The wooden core which is sometimes used as a cover for the top should be painted with a fire-resisting material.

The speaker emphasized that here is a good field to be taken up by students of electrochemistry.

DETERMINING THE SPECIFIC RESISTANCE OF ELECTROLYTES.

The first paper, presented at the session of Wednesday morning, related to a standard method for determining the specific resistance of electrolytes, the author being Mr. R. Threlfall. In his absence the paper was read by Mr. C. Hering.

The author employs the potentiometer method and makes use of single reversible electrodes, such as those of Ostwald, to connect the potentiometer to the electrolytic resistance. He measures the resistance of a long uniform cylinder, which contains the solution to be tested, and then calculates the specific resistance. The cylinder is embedded in a bath so that it may be uniformly heated to various temperatures. The two terminals of the cylinder are connected on the one hand to the standard Ostwald electrodes, a resistance box and a galvanometer, and on the other hand through platinized platinum electrodes with a storage battery which is in series with a very high resistance and furnishes the main current through the electrolyte. The main current is reversed after a group of observations and several sets of comparisons are made alternately with the current, first in one direction and then in the other. The arithmetical mean of the results is then taken.

The paper was discussed by Messrs. Hering, Burgess and Esterbrooks.

Prof. C. F. Burgess' report on the electrochemical exhibits at the Louisiana Purchase Exposition in St. Louis, 1904, was then read by title.

REVERSIBLE AND IRREVERSIBLE POLARIZATION.

A paper by Prof. W. S. Franklin and Mr. L. A. Freudenberger was presented by Prof. Franklin. It gives the results of a continuation of researches on which he had already presented a paper at a former meeting of the society. The gist of the method is to divide the total e.m.f. into a sum of three terms, the first being ri—that is,

the e.m.f. consumed by the resistance according to Ohm's law; the second being the reversible polarization, due to changes of concentration of the electrolyte, changes of temperature, etc., while the third is the irreversible polarization which is a function of the current. The endeavor of the experimental research was to separate these three terms from one another. The main part of the paper gives measurements which were so arranged as to give the values of the reversible polarization with considerable accuracy, thus enabling the values of the irreversible polarization to be found since the term ri can be calculated. The results were tabulated in diagrams. The paper was discussed by Messrs. Hering, Burgess, Bancroft and Betts.

AMMETERS FOR ELECTROLYTIC WORK.

A paper on this subject by Mr. Lawrence Addicks, of the De Lamar Copper Refining Company, was presented in the absence of the author, by Mr. Easterbrooks. For electrolytic work very heavy currents are required, and care must be taken to measure them accurately. It is necessary to place both shunt and instrument in suitable positions when designing the switchboard. In the first place the shunt should be obtained from the maker with short bars inserted in the slots usually provided in the shunt terminals, these bars in turn to be bolted to the bus-bar carrying the current to be measured. Unequal heating of the two shunt terminals will introduce a constant error from the thermo-electric junctions formed where the alloy leaves are soldered on to the copper blocks. This may easily amount to one per cent of the full scale reading; may be either positive or negative, and will show as a zero error on shunting down the circuit and will gradually disappear as the shunt cools off. Sometimes compensating devices are applied to avoid thermo-electric errors, but if the shunt is so placed in the bus-bar that the facilities for conducting away heat are approximately equal on both sides, there will be no appreciable error, and such devices should be unnecessary. There should be practically equal radiating surfaces of bus-bar for three or four feet each side of the shunt. If placed close to a switch on one side there is sure to be a thermo-electric error in the shunt, as high capacity switches frequently run hot. The best plan is not to attempt to place the shunt back of the switchboard at all.

The power wasted by a 5,000-amp. shunt at full load is about 300 watts. It is perfectly practicable to build a shunt for 25,000 amp. One of the most important sources of error is the magnetic effect of stray field in the immediate vicinity of a bar carrying several thousand amperes. Instruments should never be placed within two feet of such bars.

THERMODYNAMICS OF THE ELECTRIC INCANDESCENT LAMP.

A paper on this subject was presented by Dr. E. F. Roeber, who gave a summary of the thermodynamic theory of radiation as applied to incandescent lamps and exhibited the following three new types of lamps: the tantalum lamp, the osmium lamp and the graphitized carbon filament of the General Electric Company. An abstract of the paper will be found on another page of this issue.

The discussion was participated in by Messrs. Bancroft, Richards, Franklin and Brown, and dealt mainly with problems of optical pyrometry and with the question whether the black deposit on the globe of the carbon filament lamp is due to actual evaporation of the carbon. Prof. Richards thinks that for certain metallurgical reasons it should be assumed that evaporation of carbon takes place, even at not too high a temperature. Dr. Roeber remarked even if this takes place yet there must be some other action by which carbon particles are given off from the filament, since they are mainly given off from one terminal of the filament and are emitted in straight lines, there being a distinct screening effect under proper arrangement of the experiment. Mr. Brown called attention to the importance of finding the cause of the change which goes on in the tantalum filament during use and which results in the contraction of the filament and final destruction.

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Two papers by Prof. H. Schlundt and Prof. R. B. Moore dealt with problems of radioactivity. In one paper the authors showed that a separation of the products constituting the excited activity of thorium can be readily made by chemical means. The second paper gave an account of tests of the radioactivity of some natural waters of Missouri, mostly mineral waters. There exist marked variations in the activity of these cold waters. The activity of deep-well waters as a rule falls below that possessed by spring waters.

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ELECTRIC RESISTIVITY OF IRON.

The last paper presented at the meeting was a note by Mr. G. Gin on the electric resistivity of iron and steels at high temperatures. A certain kind of cast iron was found to have a resistivity of about 16×10^{-5} microhm-centimeters for temperatures between 1,280° C. and 1,340° C. In the discussion Prof. Richards welcomed this paper as one which should be followed by a great many others, since for metallurgical calculations nothing is more needed at present than such data.

Prof. Burgess proposed and Mr. Hering seconded a vote of thanks to the local committee and to the various authorities which had made this meeting so very enjoyable and successful in spite of the inclement weather. A great part of this success was due to the very effective work done by the local committee with Dr. W. J. Richards and Mr. Landis as chairman and secretary, respectively.

The excursion to Mauch Chunk which had been arranged for Wednesday afternoon had to be given up on account of the rain, but those who remained in Bethlehem either paid a visit to the Dexter Portland Cement Company at Nazareth, Pa., or participated in the impressive ceremony of the opening exercises of Lehigh University in the university chapel.

Telephone Capitalization.

Telephone companies to the number of 247 have made returns to the Indiana Tax Board. Their reports are more or less interesting, as many of the companies are overcapitalized, and their service rates are so low that it is becoming a question whether they are earning sufficient money to pay general and operating expenses, depreciation and a reasonable profit on the investment. A comparison of the capitalization of the twelve largest independent companies in the State with that of the Central Union Telephone Company shows the average capitalization per telephone of the independents to be $172 to $91 per station of the Central Union. It is claimed that this shows a large overcapitalization of the independents. Another significant feature is the low estimate of the cost of the plants of the independents, figuring depreciation at 7 per cent, allowing 6 per cent interest on the real cost of the plant and using the companies' sworn figures as to gross earnings and operating expenses, eleven out of the twelve companies showing a deficiency in earnings. The Bell people say these facts become all the more interesting when compared with the report of the secretary of internal affairs for the State of Pennsylvania, which places the average Bell capitalization per telephone in the state at $93, and that of the independents at the enormous figure of $347.

Another significant condition existing in Indiana is the alleged fact that of the 247 companies listed, 70 are sub-licensees of the Bell company, and are, for all practical and comparative purposes, a part of the Bell system.

A Home for Science in New York.

The scheme of the Scientific Alliance of New York to raise $500,000 for a building for the use of the allied scientific societies of New York will be actively pushed this autumn. Charles F. Cox, treasurer of the Michigan Central Railway Company, the president of the Scientific Alliance, announces that about $100,000 has been subscribed contingent upon the Alliance raising $250,000. Of that amount J. Pierpont Morgan had subscribed $25,000, and it was hoped that he would considerably increase the sum. Another subscriber was Mr. D. Adams, and Mrs. Esther Hermann had paid in $10,000.

Mr. Cox said the city would be asked for a site, as it was proposed to found an institution for New York which should combine the objects of Burlington House and the Royal Institution of Great Britain with the addition of a department for the issue of a series of work

the e.m.f. consumed by the resistance according to Ohm's law; the second being the reversible polarization, due to changes of concentration of the electrolyte, changes of temperature, etc., while the third is the irreversible polarization which is a function of the current. The endeavor of the experimental research was to separate these three terms from one another. The main part of the paper gives measurements which were so arranged as to give the values of the reversible polarization with considerable accuracy, thus enabling the values of the irreversible polarization to be found since the term ri can be calculated. The results were tabulated in diagrams. The paper was discussed by Messrs. Hering, Burgess, Bancroft and Betts.

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The last paper presented at the meeting was a note by Mr. G. Gin on the electric resistivity of iron and steels at high temperatures. A certain kind of cast iron was found to have a resistivity of about 16×10^{-5} microhm-centimeters for temperatures between 1,280° C. and 1,340° C. In the discussion Prof. Richards welcomed this paper as one which should be followed by a great many others, since for metallurgical calculations nothing is more needed at present than such data.

Prof. Burgess proposed and Mr. Hering seconded a vote of thanks to the local committee and to the various authorities which had made this meeting so very enjoyable and successful in spite of the inclement weather. A great part of this success was due to the very effective work done by the local committee with Dr. W. J. Richards and Mr. Landis as chairman and secretary, respectively.

The excursion to Mauch Chunk which had been arranged for Wednesday afternoon had to be given up on account of the rain, but those who remained in Bethlehem either paid a visit to the Dexter Portland Cement Company at Nazareth, Pa., or participated in the impressive ceremony of the opening exercises of Lehigh University in the university chapel.

Telephone Capitalization.

Telephone companies to the number of 247 have made returns to the Indiana Tax Board. Their reports are more or less interesting, as many of the companies are overcapitalized, and their service rates are so low that it is becoming a question whether they are earning sufficient money to pay general and operating expenses, depreciation, and a reasonable profit on the investment. A comparison of the capitalization of the twelve largest independent companies in the State with that of the Central Union Telephone Company shows the average capitalization per telephone of the independents to be $172 to $91 per station of the Central Union. It is claimed that this shows a large overcapitalization of the independents. Another significant feature is the low estimate of the cost of the plants of the independents, figuring depreciation at 7 per cent, allowing 6 per cent interest on the real cost of the plant and using the companies' sworn figures as to gross earnings and operating expenses, eleven out of the twelve companies showing a deficiency in earnings. The Bell people say these facts become all the more interesting when compared with the report of the secretary of internal affairs for the State of Pennsylvania, which places the average Bell capitalization per telephone in the state at $93, and that of the independents at the enormous figure of $347.

Another significant condition existing in Indiana is the alleged fact that of the 247 companies listed, 70 are sub-licensees of the Bell company, and are, for all practical and comparative purposes, a part of the Bell system.

A Home for Science in New York.

The scheme of the Scientific Alliance of New York to raise $500,000 for a building for the use of the allied scientific societies of New York will be actively pushed this autumn. Charles F. Cox, treasurer of the Michigan Central Railway Company, the president of the Scientific Alliance, announces that about $100,000 has been subscribed, contingent upon the Alliance raising $250,000. Of that amount J. Pierpont Morgan had subscribed $25,000, and it was hoped that he would considerably increase the sum. Another subscriber was Mr. D. Adams, and Mrs. Esther Hermann had paid in $10,000.

Mr. Cox said the city would be asked for a site, as it was proposed to found an institution for New York which should combine the objects of Burlington House and the Royal Institution of Great Britain, with the addition of a department for the issue of a series of works

similar to those published by the Royal Society and other learned bodies abroad.

It had been suggested that a wing be added to the American Museum of Natural History or the New York Public Library as a home for the Alliance. The latter proposition, Mr. Cox said, had been advocated not only by the late Andrew H. Green, but by Morris K. Jesup and Andrew Carnegie. Mr. Cox said there were about 1,200 members of the Scientific Alliance waiting to be housed, and half a dozen other scientific societies that would be glad to have a central home. At present these bodies enjoy the hospitality of Columbia University.

George Washington University.

The George Washington University, Washington, D. C., has enlarged its educational work very materially in the establishment of another division in its department of arts and sciences, to be known as the College of Engineering. To this college has been assigned the supervision of the courses of study and technical training required for the degrees in civil, electrical and mechanical engineering; and for the accommodation of its work the old Van Ness mansion, around which the main group of new buildings for the university will be erected, is being fitted up.

The adaptation of the Van Ness mansion for purely technological educational work is a very important and significant step in the rapid and broad development of the university that has characterized the administration of President Needham. Those who for years have been identified with the formulation and development of the engineering courses now offered express great satisfaction at this early provision for the greater future of the university in its engineering departments.

The structural arrangement of the building lends itself admirably to the new service. The architectural features of the building will not be altered; the improvements will be in the nature of restoration. The foundations and walls are intact and well fitted to withstand the vibrations of the machinery that will be installed. Its interior arrangement will provide amply for the several branches of the engineering courses. The basement will be used for heavy machinery, such as engines, dynamos, lathes, construction appliances, etc.

On the first floor the lighter machinery, testing apparatus, mechanical and electrical measuring instruments, laboratories, etc., will be placed. The draughting rooms and class rooms will be located on the second floor. The engineering work of the university will be centered in this building, but the general university subjects will, as heretofore, be taught in the class rooms of the administration building, the class rooms in the Van Ness building to be used for strictly engineering courses.

CURRENT NEWS AND NOTES.

WIRELESS IN FLORIDA.—Messages are now being exchanged between Pensacola and Key West, a distance of 460 nautical miles. The only obstacle to prevent continuous communication is the strong and constant "static," a condition peculiar to these latitudes. During the summer months long distance communication can be carried on only between 6 and 9:30 a. m., it is said. It was found that a 2¼-in. spark was necessary to transmit signals over this distance, with 25,000 volts on the secondary of the transformer. The length of wave used is assumed to be about 700 meters.

INSTRUCTIONS BY WIRELESS TO SHIPS AT SEA.—The United States cruiser *Columbia* has gone to sea to find and destroy the abandoned lumber-laden schooner *Edward L. Warren,* which has been bothering navigators from Southern ports since last May. Commander Boyer, of the *Columbia,* which is fitted with wireless, made arrangements with the Navy Yard at Brooklyn to have the latest report about the location of the derelict sent to him while he was searching for her. The steamship *India* passed the *Warren* about 110 miles east by south of Sandy Hook on September 21. This information was telegraphed to the branch Hydrographic Office at New York. Capt. A. J. Keegan, in charge of the office, notified the Navy Yard and a wireless message was sent to the *Columbia,* then about fifty miles off the Hook. She acknowledged the receipt of the message, and doubtless will find and blow up the hulk. This is the first time that wireless has been used to locate a derelict, and this use of it illustrates the many possible special adaptations of the system.

WIRELESS MIX-UP IN CHICAGO.—A Chicago dispatch, dated September 22, says: "Two of Chief Collins's detectives went to Buffington, Ind., last night where they were arrested by a score of constables and held in a cell until to-day. The detectives belong to the gambling squad and were experimenting with a wireless instrument in an attempt to intercept messages for the floating poolroom. Chief Collins will protest to Governor Hanly against the conduct of the constables."

LOCKOUT IN GERMANY.—A cable dispatch from Berlin of September 21 says: "It is learned to-night that the Allgemeine and Siemens-Halske electrical companies have decided to lock out about 10,000 of their employees to-morrow. This lockout will affect the cable works of the Allgemeine Company on the Upper Spree and the dynamo works of the Siemens-Halske Company at Charlottenburg. Trouble between the great electrical companies of Berlin and their employees has been brewing for some time. The workmen in several departments of the two chief companies have already gone on strike. The men say that living has grown so expensive owing to the high price of wheat and other articles that their wages are insufficient. The electrical companies of Berlin employ at least 60,000 men."

INDEPENDENT TELEPHONE MAPS.—The National Interstate Telephone Association has begun the preparation of maps, showing the independent telephone development throughout the country. These maps are being made up by states, and only data which is absolutely reliable is being used in their preparation. When completed they will be an accurate record of the existing independent lines through the country, and will be constantly kept up to date, new lines being added as rapidly as completed and reported. Every independent telephone company in the country has been requested to send to Cleveland a map of all toll lines which they operate, dividing their lines into two classes: A, copper lines of No. 10 gauge or heavier; B, copper lines of No. 12 or No. 14 gauge, and all iron lines. Long distance companies especially are urged to furnish maps and data regarding their through lines and connections.

PATENT LAWS.—The following comment is from the *Electrical Times* of England as to some recent correspondence in our columns: "There is always a great deal of discontent with the patent laws and their administration. There is good reason for it; patent laws are never satisfactory, at least to inventors. Mr. Ludwig Guttman has written giving his views to the *Electrical World and Engineer* of New York. One of his main contentions is that a patent case should be tried before experts, not before an untechnical judge. It sounds very well to say that an impartial and qualified expert would be the best judge. But how are we to get him? If you ask anyone with those notions whom he would recommend, you find he really means himself, and has no one else to put forward. If you take a concrete example the difficulty is more easily realized. Suppose there had been an action on the multiphase patents, who would have been a good expert? You want a man who would understand the subject thoroughly, of course, and who has no personal, professional, or trade connection with either side, or preferably with even the experts on each side. But this is not all, by any means. He must understand the rules of evidence, he must be able to deal with two teams of barristers, and he must be well versed in patent law; itself a pretty big subject. In Germany the patent office often gets what it thinks is assistance from various university professors. This is a great hardship to inventors. They find they have to deal with men who start with the idea that practical men know nothing, and never know or invent anything, and they are unable to see the difference between a chance reference to a fact in a theoretical book and a worked out invention. In addition to this they think they know all about the subject *ex-officio,* and absolutely refuse to be taught anything. Anyone who has had experience with the German office has found all this out to his cost. In this country either side can ask for an expert to sit as assessor with the judge; but I believe no side has ever done so yet. Twice or thrice a judge has asked for an assessor. One reason for this is that the best experts are already retained by the litigants, but the real cause is distrust of the mind that is untrained judicially, and is ignorant of law."

A SMOKELESS PITTSBURG.—It is stated that Messrs. A. J. Warner, H. C. Frick and George Westinghouse, Jr., are interested in a plan to make Pittsburg smokeless. It is proposed to erect a large power plant about twenty-five miles out which will furnish light and power to Pittsburg and surrounding towns.

THE PHOSPHORESCING DIAMOND.—According to Sir William Crookes, the most remarkable diamond in the world is owned by Mrs. George F. Kunz, of New York. The gem in question is a "phosphorescing diamond," and, according to Sir William, it will phosphoresce in the dark after being exposed to a small pocket electric light, and if rubbed on a piece of cloth leaves a long streak of phosphorescence. This diamond was exhibited by Dr. Kunz, the gem expert, at the New York Electrical Exhibition of 1896, with the aid of an arc light, which stimulated the phosphorescent effect very markedly.

UNIVERSITY RAILROAD COURSE.—The University of Chicago has established a four-year course in railway education. An advisory board, composed mostly of railroad men, has been established, with F. W. McKenna, assistant to President Earling, of the Milwaukee & St. Paul, as chairman, and Daniel Willard, second vice-president of the Burlington, as vice-chairman. These men will shape the courses and will themselves deliver lectures. The first year's course will be devoted to railway conditions in the United States, the second to freight service, railway transportation, railway law and rate regulation; the third to passenger service, statistics and geography of railways, signaling and train service, railway auditing and finance and terminals; the fourth to motive power, car equipment, track, railway development abroad and the economics of railway locomotion. This is something like the transportation course started by Dr. Sheldon at the Brooklyn Polytechnic Institute.

RECENT NIAGARA FIRE.—Mr. John L. Hooper, chief engineer of the Niagara Falls (N. Y.) Hydraulic Power & Manufacturing Company, writes us as follows with regard to the recent fire there: "I would say that the fire was entirely upon the wires owned and operated by one of our customers, namely, the Pittsburg Reduction Company, and that the only effect upon our company was that these wires passed through a gate house over one of our waterways, and although this gate house was to some extent damaged by the burning of the insulation of these wires of our customer, no damage was done in the power station of this company; nor did the fire extend to that building, nor were any conduits or works of the Niagara Falls Hydraulic Power & Manufacturing Company, outside of the gate house mentioned, affected by this fire. The power was temporarily removed from the other lines operated by this company, merely for the safety of the firemen engaged in extinguishing the burning insulation, and all power delivered to the other customers of this company was at once established upon the firemen leaving the building."

CENTRAL STATION ADVERTISING.—President Blood, of the National Electric Light Association, has appointed Mr. Paul Spencer, of Philadelphia; Mr. John F. Gilchrist, of Chicago, and Mr. Joseph E. Montague, of Niagara Falls, as a committee to cooperate with the advertising committee of the American Association of Incandescent Lamp Manufacturers in the matter of assisting central stations in the adoption of advertising methods that will result in increased business. The lamp manufacturers' association made an offer to the national association at its Denver meeting of $10,000 to be expended for the above purpose, and the offer being accepted this committee has been appointed to complete plans for the work. One of the most important discussions at the Denver meeting was that upon advertising and general methods of getting new business, and it was pretty well shown that this part of the central station management was about the most important of all, yet in the majority of cases the most neglected, or the most imperfectly carried out. The papers and discussions on the subject created great interest and enthusiasm among the representatives of the smaller stations, and many of the suggestions made in the papers and discussions were at once acted upon when they returned to their homes, and in several cases most gratifying results have been reported. The work of the present committee will undoubtedly be one of the most helpful things ever done for the members of the association.

ELECTRICITY IN WASHINGTON.—Mr. Walter C. Allen, the electrical engineer for the District of Columbia, has asked for $464,000 for 1906-7 as compared with $379,000 in the current fiscal year. The electric lighting needs to be increased, $2,000 is needed for trimming trees around public street lamps and $12,000 is required to put in a central energy telephone switchboard replacing the magneto board.

WIRELESS AND RAILWAY ACCIDENTS.—It is stated that disastrous railway accidents in Germany will probably lead to the general introduction and use of wireless telegraphy on all the State railways. Two years ago experiments were begun on the military railway from Berlin to Zossen. The telegraph stations on the route were each fitted up with a transmitter and receiver, while the trains were equipped with the same apparatus. The ordinary telegraph wires along the track were also used to facilitate the work. The experiments proved conclusively that the different stations could at any time communicate with a train running at full speed and warn it of impending danger. The use of wireless telegraphy in this connection would especially safeguard trains on one-track railways. It is not believed that the expense of supplying stations and passenger trains with the necessary apparatus will be much beyond the budget allowed each year for the purpose of repairing old signals and introducing new appliances and inventions which have for their aim the protection of life and limb in railway travel.

ELECTRICAL EXHIBITION IN CHICAGO.—A company has recently been organized in Chicago to hold an electrical exposition in which will be shown electrical machinery, appliances and apparatus in all branches of the industry. This show will be held in the Chicago Coliseum January 15 to 27, 1906. The exposition will be for the information and instruction of the general public in the various uses to which electricity is applied in which the public is vitally interested, and will also interest and benefit the electrical trade, the engineer, manufacturer, dealer and scientist. The name of the company is the Electrical Trades Exposition Company and includes as stockholders 75 of the leading electrical men of Chicago. It is officered and managed by men well known in the electrical industries of Chicago, the officers being as follows: Mr. Samuel Insull, president; Messrs. E. B. Ellicott, Charles E. Gregory and E. B. Overshiner, vice-presidents; Mr. John J. Abbott, treasurer; Mr. Stewart Spalding, secretary; Mr. Thomas R. Mercein, general manager. The following is a list of the directors: Samuel Insull, Edward B. Ellicott, T. P. Gaylord, James Wolff, H. B. McMeal, C. E. Mitchell, Homer E. Niesz, E. B. Overshiner, G. H. Atkin, Stewart Spalding, Charles E. Gregory, G. Edward Kohler, George B. Foster.

A NEW HUDSON TUNNEL.—Incorporation papers have been filed at Albany and Trenton for another tunnel under the North River, connecting Jersey City and New York. The title of the new corporation is the Interstate Tunnel Railway Company, and its financiers and incorporators are the New York City Railway Company (the old Metropolitan) and the Public Service Corporation of New Jersey. Although the company has been incorporated, it has not yet obtained any franchise or any authority from the State Railroad Commission or the local authorities. The incorporating companies intend to use the tunnel exclusively and as a feeder to their branches and have been organized for the purpose of constructing a tunnel from the terminus in Jersey City, at Erie and Twelfth Streets, to a terminus under Chambers Street, between Broadway and the Brooklyn Bridge terminal, in the Borough of Manhattan. It is intended to provide thereby better means of communication between the business portions of the City of New York and the territory served by the Public Service Corporation, which operates all the surface lines in the counties of Hudson, Essex, Passaic, Union and Middlesex, in New Jersey, comprising about 550 miles of line. The Public Service Corporation proposes to supplement its existing facilities in New Jersey by a new direct high-speed line from Newark, with communication, without changes, to the proposed tunnel in Jersey City, thus affording direct transportation from its terminus in Newark to the City Hall in New York in fifteen minutes. Arrangements have also been made for a joint passenger station at Jersey City, which will enable the Erie Railroad Company to transfer its suburban passengers to the proposed tunnel line. The New Jersey company has an authorized capital of $7,500,000.

GAS IN LONDON.—Figures show that the gas business in London is falling off. No more gas is sold now by the Gas Light & Coke Company than it sold seven years ago, and the quantity was less in the last six months than it was in 1900.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.—Mr. William S. Boyd, secretary of the Western Association of Electrical Inspectors, announces a meeting of this association to be held at 10 a.m., October 5 and 6, 1905, at rooms 1232-4-6, National Life Building, Chicago.

WESTERN SOCIETY OF ENGINEERS.—The first meeting of the season of the Electrical Section of the Western Society of Engineers will be held at the society rooms in the Monadnock Block, Chicago, Friday evening, October 13. Mr. James R. Cravath will give a paper, illustrated with numerous lantern slides, on the subject: "Do We Need Better Illuminating Engineering?"

ELECTRICAL COMMISSION.—At the first public hearing of the recently created New York State Commission of Gas and Electricity, applications from the Palmyra Gas & Electric Company and from the St. Lawrence River Power Company, of Massena, for permission to increase their bonded indebtedness were considered. The Clyde Gas & Electric Company asked for the approval of its certificate of incorporation, with a capital of $25,000. The Wayne Electric Company, said to be a rival of the Clyde Company, telegraphed that it wished to be heard on the subject.

LONG WESTERN TROLLEYS.—Another long stretch of trolley spans the Middle West. With the completion of the Western Ohio Traction Line, from Findlay to Lima, there is an unbroken trolley line from Cincinnati to Cleveland. The route is from Cincinnati to Dayton via the Cincinnati, Dayton & Toledo, from Dayton to Findlay to Pemberville via the Toledo, Fostoria & Findlay, and from Pemberville to Cleveland via the Lake Shore Electric. The distance, 294 miles, can be made with only four changes of cars. Of course the time is much longer than that of the steam roads, but the fare is much less.

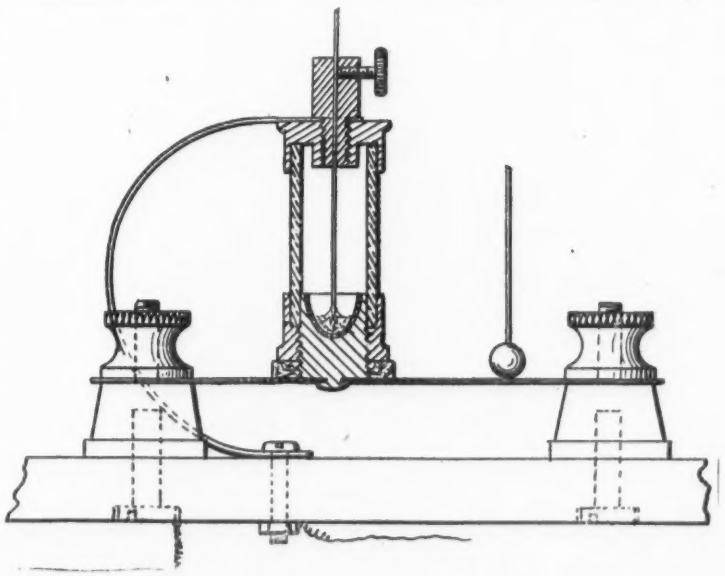
ELECTRICALLY WELDING RAIL JOINTS.—In a patent granted Sept. 19 to Carl Pahde, of Berlin, Germany, there is outlined a method for welding rail-joints which involves the use of the electric arc. The rails are connected with one pole of a source of direct-current, the other pole of which is connected with an arc-lamp carbon. The rail-foot is then lightly touched with the carbon, and there is produced an arc which completely melts the feet of both rail ends. By adding pieces of iron of suitable composition, the melted metal is increased until it fills a form which surrounds the rail ends. This form may consist of fire brick, but the inventor prefers to make it of iron, and to melt it also by means of the arc at its inner surface. It is then rigidly connected with the rail-foot after the welding, and increases the strength of the weld.

ELECTRIC AUTOMOBILES.—A short description was printed last week of a combined engine and motor automobile which had just been patented by H. Lemp. On Sept. 19, another patent was issued to the same inventor for a somewhat similar machine. According to the later scheme, the two driving motors remain at all times electrically connected to a self-excited direct-current generator, the armature of which is mounted upon the shaft of a gas engine. The variation in speed of the motors is obtained by changing the speed of the engine through a limited range above and below the critical exciting speed of the generator. At the lower range of speed, the generator fails to excite itself, and the motors come to rest. On this same date a patent was issued to J. LeC. Davis for a self-propelled vehicle which is a modification of a former invention of Lemp. On a shaft, which serves to drive the automobile, is mounted a motor and one of the outside members of a differential gear, to the other outside member of which is connected a generator, and the central member is connected to a gas engine. The gas engine is run at constant speed, while the speed of the automobile is varied by changing the field strength of the generator, or by varying the electrical connections between the generator and the motor. Both of these patents have been assigned to the General Electric Company.

DEPARTMENT STORE TELEPHONY is a feature now being developed by the New York Telephone Company. The large departmental stores have been installing telephones in large numbers. The idea is to put a telephone on practically every counter. Communication within the store is free and messages are sold at each station. There is, therefore, a pay station at every counter. In New York Siegel, Cooper & Co. have taken 1,000 telephones and Lord & Taylor 500. For the use of Siegel & Cooper 50 trunk lines will be necessary; for Lord & Taylor 40 trunk lines will be employed. In Philadelphia the Bell Company has also entered into a contract with some of the large stores for a service of this character. Gimble Bros. are taking 1,000 telephones, Strawbridge & Clothier have 500. Marshall Field, of Chicago, is said to have been the pioneer in this sort of thing, but the Marshall Field store has only about 300 telephones. In this instance the East has taken up a new idea more eagerly than the West, in which it originated. It is obviously very convenient for people while buying to consult or get in touch with the interested folks at home.

A LONG PENNSYLVANIA TROLLEY.—The Philadelphia & Western is now under construction paralleling the Pennsylvania R. R. for a considerable distance. The first section, twelve miles long, from Sixty-third and Market Streets to Wayne, is being built. Ultimately with branches it will be ninety-six miles long. The road does not get into Philadelphia, but reaches that part of the city line which is closest to the City Hall, and connects with the elevated road of the Philadelphia Rapid Transit. It will be a third-rail system over a private right of way. The first twelve miles is to have double tracks, but the construction is such that the road may readily be increased to four tracks as the traffic demands. All the culverts and bridges have been put on a four-track basis. The road is designed to give a high-class suburban passenger and freight service. The equipment will be made up of large heavy cars of the multiple-unit type. The electric equipment is being furnished by the General Electric Company. The road will be rock-ballasted and will have 85-pound rails. An issue of $15,000,000 bonds has been authorized and of these $1,660,000 have been issued so far on the construction and equipment of the first twelve miles of the road.

MASSIE COHERER.—The accompanying illustration shows a form of coherer for which a patent was issued Sept. 19, to W. W. Massie. The coherer involves a magnetized needle supporting at its lower end some magnetic filings which are embedded upon or in non-magnetic filings. The resistance of the coherer can be varied by changing the superficial area of the top of the filings mass in the containing cup. The interior of the lining of the cup is of progressively-increasing cross-sectional area from its bottom to its top, so that the superficial area will be in accord with the amount of filings in the cup. The needle is contained within a glass tube, the opposite ends of which fit in metallic collars serving as terminals. The coherer is so designed that its parts can be readily assembled to present an operative organization and as easily separated when occasion requires.



IOWA INDEPENDENT TELEPHONE ASSOCIATION.—The Northeastern Iowa Independent Telephone Association held a convention at Waterloo, Iowa, September 15, which was attended by representatives of more than half of the number of independent companies in the district. Among the matters considered at the meeting was the question of organizing the entire State into districts for the advancement of independent interests. Mr. C. C. Deering, secretary of the Iowa Telephone Association, was present and explained the organization of the State telephone clearing house. Mr. Stanley S. Lichty, Waterloo, Iowa, is secretary of the association first named.

TECHNICAL EDUCATION.—Mr. William Barclay Parsons, in a recent address on "The Practical Utility of Technical Training," gave some interesting educational statistics relating to the engineering force engaged in building the New York rapid transit Subway. The staff of engineers numbered about 200 on the average, exclusive of inspectors, and was divided into three classes: The executive, or those engineers holding positions of responsibility, and who were called on for original thought in designing as well as for ability in execution; the assistant engineers, holding positions of less trust, men of less experience carrying out the orders of their superior officers, though still with responsibility; and third, the rodmen, those just beginning engineering work, called on for no originality, but acting entirely under instructions. All of these positions, except those in the first class, were filled after competitive civil service examination. Of the first two classes 86 per cent were college graduates from leading institutions, while of the third, where such education was not in any way a necessary requirement, not less than 58 per cent had passed through some college of recognized standing.

MORAL QUALIFICATIONS OF ENGINEERS.—In an editorial in the September issue of the *Club Journal*, Mr. Charles F. Scott quotes an engineer of wide experience in this country and abroad, now holding an executive position with a progressive company, as saying that in selecting young engineers for specific work he found a greater number were lacking in moral qualifications than in technical ability. He did not restrict the term "moral" to mean simple, common honesty, but used it in a broader sense to include courage, judgment, backbone, moral strength and all those things which make up the complex called character. Commenting on this remark, Mr. Scott says that it is easier to train engineers than it is to develop men. "College courses are apt to give 99 per cent to technical subjects and one per cent to culture studies. Were the divisions 85 per cent and 15 per cent, one would be decreased by only a seventh, while the other would be increased fifteen-fold. When older men talk about the value to an engineering student of a debating society, of familiarity with parliamentary practice, of fluency in composition, of culture studies, of the training in effective co-operation which may be secured through student organizations, of education as a means of forming right habits and developing the faculties as well as acquiring technical knowledge, the student in engineering does not seem to understand what they mean. The development of this broader side of life must be after all a matter of individual choice and effort. Others may counsel and may inspire. The result depends upon the man himself, upon what he chooses to bring within the range of his experience and upon the success with which he assimilates that experience in his growth. No one who has caught the spirit of the modern engineer will think that this applies to school days only. The principle of progress is to keep on. The ideal is not static but kinetic, as well for the individual as in society and science and engineering."

Electrical Engineers of the Times.—XXIX.

MR. A. E. WINCHESTER.

Albert Edward Winchester, of New England and Southern ancestry, was born April 19, 1867, at Marietta, Ohio. His father, Theodore H. Winchester, deceased, was an editor, an artist and an inventor of printing appliances. His mother, Anna Maud Jackson, was an educator and a worker in various lines of literature. His early education was received in Ithaca and New York City. At the age of fourteen he accompanied his mother to Mexico, and there being no suitable schools for an American youth in those days, and having already developed a strong inclination toward constructive mechanics, he became an apprentice in the motive power department of the Mexican Central Railroad, which was then being built to the United States. On completing his term in 1883 he was sent to the United States to qualify for college, and took a preparatory course at the Whitlock Academy at Wilton, Conn. Having become deeply interested in electricity, instead of entering college at the conclusion of his academic career, he became the youngest member of the parent Edison Company's engineering staff, and continued with the various organizations of that company in line of succession from draughtsman to consulting engineer, until the formattion of the General Electric Company, with which he remained until 1893, when he became a member of the Electrical & Mechanical Engineering Company, of New York, and also its superintendent of construction for the three ensuing years.

During 1896-7 Mr. Winchester was on the engineering staff of the New York Edison Illuminating Company. From that time to the present he has held the position of general superintendent of the City of South Norwalk Electric Works, having designed and supervised the construction of this plant back in 1892. From 1892 to 1902 he served as one of the electrical commissioners of South Norwalk, and in the latter year was appointed city electrical engineer, retaining

A. E. WINCHESTER.

also the position and duties of general superintendent of the municipal plant.

In the line of invention Mr. Winchester never took out any patents, holding that those who employed him were entitled to his efforts. He is the originator of one of the first practical quick-break switches for heavy currents, the principles of which are in general use to-day. The sectional iron bracket pole for supporting trolley lines was developed by him. He invented an early car motor controller and aided in the evolution of the one that later became standard. He contributed many improvements and modifications to trolley line construction and appliances, to which work he was assigned for a considerable period of time. He was also frequently detailed on special lines of work under the direction of Mr. Edison.

Mr. Winchester's specialty, however, was largely in the line of power station engineering, and he participated in the designing of over one hundred electric lighting and street railway power plants, of which some were erected under his personal supervision. Among the important lighting plants in the designing of which Mr. Winchester took an active part, were the early Edison stations at New York, Boston, Philadelphia, Chicago, Cincinnati, San Francisco, New Orleans, Kansas City, Milwaukee, Detroit, Providence, Paterson and many others. He was one of the engineers connected with the construction of the Richmond Electric Street Railway (the pioneer road of the old Sprague Electric Railway & Motor Company), the Sprague road at Scranton and various others.

Mr. Winchester is a member of the American Institute of Electrical Engineers, and an honorary member of the National Association of Stationary Engineers.

Electric Light, Water Works and Central Hot-Water Heating Installation at Ada, O.

BY A. E. BUCHENBERG.

AS plant operating expenses increase and the demand for more perfect and uninterrupted service becomes insistent, it is imperative that the generating and distributing apparatus and appliances of a modern installation be of the best mechanical construction and of the highest possible efficiency under the particular service required. Also that the design of the plant be such as to afford the maximum utilization of the calorific value of fuel with a minimum of condensation, friction and leakage losses. The latter consideration indicates that the different departments of public-service installations, such as light, heat, power and water, should, for economical reasons, be consolidated into one system and under one roof, in this way keeping the unavoidable losses at the lowest point, and affording the minimum cost of operation, maintenance and attendance.

The success of the plant of the Ada Water, Heat & Light Company, of Ada, Ohio, from a financial and engineering standpoint, has led the writer to believe that a general description of this installation would be of interest. The plant was placed in operation in 1902, and has now been in constant service for a sufficient length of time to afford a definite criterion from a financial view of the advisability of a combination of this character in plants of moderate capacity.

The building, shown in Fig. 1, is a brick and stone structure,

FIG. 1.—VIEW OF EXTERIOR OF STATION.

113 ft. in length and 74 ft. in width, covered with a slate roof and provided with large ventilators over the boiler room. The engine and boiler rooms are separated from each other by a fireproof brick wall, the only communication between them being a small sheet iron covered door. A portion of the boiler room is partitioned off by dust-proof walls for coal bunkers which face the boilers, making it unnecessary to handle the coal but once after it is unloaded from the side track into the building. One half the engine room is excavated to a depth of 8 ft., and in this concrete lined pit are set all hot and cold water pumps, condensers, feed-water heater, etc.

The boiler equipment (Fig. 5) consists of three 18x6-ft. butt-and-strap triple riveted Brownell tubular boilers with 36x38-in. domes, set in one battery, and equipped with herring-bone grates. Provision is made for a fourth boiler when necessary.

The steel smoke chimney, which is located just outside the building, is 52 in. in diameter and 80 ft. in height, and is mounted on a brick stub 20 ft. high. A large sheet steel smoke connection extends directly from the chimney across and above the front of the boilers. Two of the boilers are arranged with a 5-in. blow-off, and are so connected as to allow their use either for generating steam or as auxiliary circulating boilers for the hot water heating system.

Feed water is supplied by a 6x4x6-in. Smith-Vaile duplex hot-water pump, taking water by gravity from a Hoppes open horizontal heater; and by a secondary arrangement of three Penberthy injectors so connected as to allow any one or all to feed any one boiler or all boilers together. The injector suction line is arranged to take water from a cold water main or directly from a well.

Especial precautions were taken in setting the boilers to obtain the best possible heat insulation, the walls being extra thick and built with a 2-in. air space, and the boilers completely covered with a three-brick arch. Where necessary to allow for expansion,

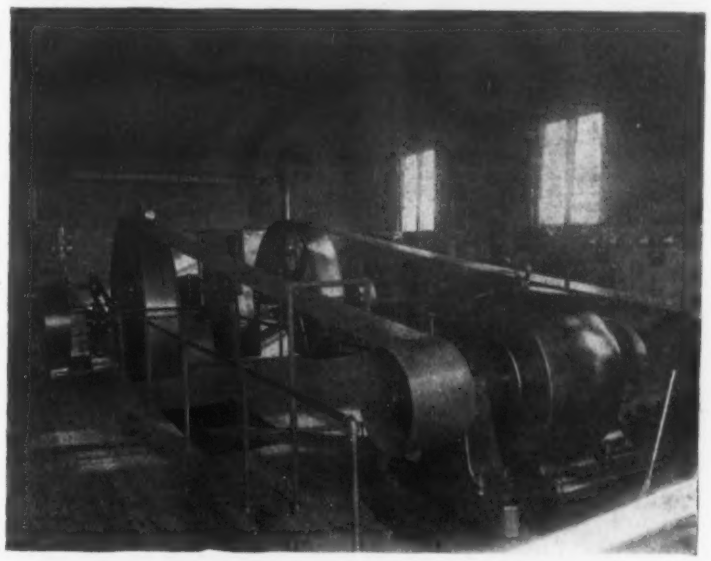


FIG. 2.—VIEW OF DYNAMO ROOM.

shredded asbestos was loosely inserted. All boilers feed into a double 10-in. steam header, and are each equipped with two independent cutout valves in the risers as a safety precaution during cleaning or repairs.

The engine equipment consists of two 10x30-in. Lane-Bodley Corliss engines equipped with independent Cochrane vertical steam separators, and set "right and left" with extended shafts in line. Upon the abutting ends of the two shafts is mounted a 36-in. Hill friction clutch for coupling the two engines together. The exhaust steam can be used in the condensers of the heating system, in the feed-water heater, or by a valve adjustment can be proportioned between them. Exhaust to atmosphere is provided through a 12-in. back-pressure valve set at two pounds.

Each engine is belted to a 75-kw, 2,300-volt, 60-cycle, single-phase Warren alternator running at 600 r.p.m. This arrangement of engines and generators while facilitating parallel operation, allows

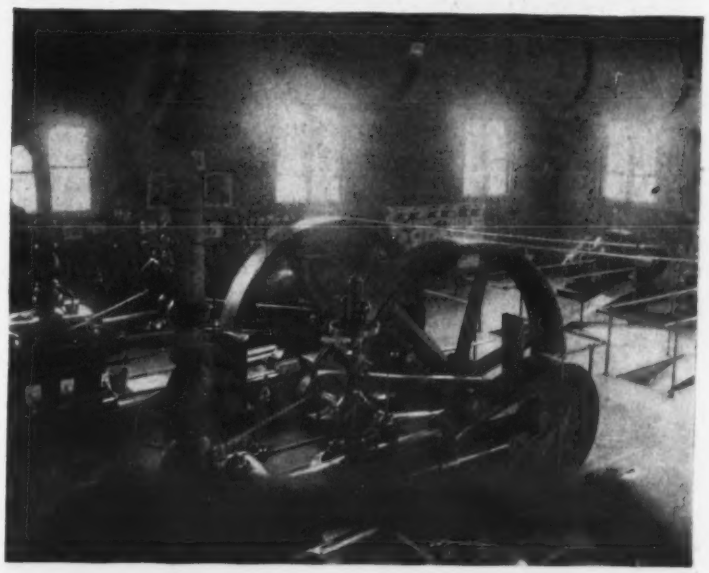


FIG. 3.—ENGINE ROOM, SWITCHBOARD IN BACKGROUND.

the use of one engine and generator of half the total capacity on light loads, and affords the greatest possible assurance of at least partial operation in case of accident to the engines or generators, by means of cross connecting the engines.

The Vermont marble switchboard is built up in three panels with instruments and appliances as follows: On No. 1 panel are mounted

a voltmeter, ammeter, and ground detector, exciter and generator field switches, throw-over switch and exciter shunt and series rheostats. Except in the substitution of an integrating wattmeter for the ground detector, machine panel No. 2 is a duplicate of No. 1. On the third or distributing panel are mounted two ammeters, two incandescent circuit switches and the necessary plug switches for two Helios-Upton series arc circuits.

The arrangement of the switchboard wiring is such as to allow perfect flexibility in operating the several circuits from the two machines. Line switches are installed and connected in such a manner as to allow their use on either machine singly, or on the two together when in parallel.

Each exciter is of sufficient capacity to excite both alternators, and connected so as to allow the use of one exciter on either machine, or on both together. The arrangement of engines and generators is clearly shown in Figs. 2 and 3.

The Yaryan central heating system is used. The distribution mains are about three miles in length and vary in size from 2-in. to 10-in. The mains are enclosed in a cypress box, built up with triple air spaces, all openings around and between the pipes being packed with "process" shavings. The insulating boxes are thoroughly underdrained with 3-in. tile, and covered with tarred roofing paper. Expansion and contraction—a most important consideration in central heating underground construction—is taken care of by means of slip expansion joints and U-bends, and anchors located about 300 ft. apart. Slip expansion joints, while expensive in themselves, require a manhole in addition, and have proven unsatisfactory on account of leakage and the tendency to corrode and seize during the summer season. To overcome the above objections a number of sets of U-bends were substituted and are giving the best of satisfaction with a much lower initial cost of installation. Cut-off valves of the gate pattern are installed at frequent intervals in manholes. Under normal operating conditions the temperature loss has been found to be approximately one degree per 1,000 ft. of main.

The station circulating system consists of two duplex Laidlaw-Dunn-Gordon hot-water pumps 10x12x13-in., one of which is built for high-pressure duty, and is so connected as to allow its use as an auxiliary fire pump on the cold-water system in case of accident

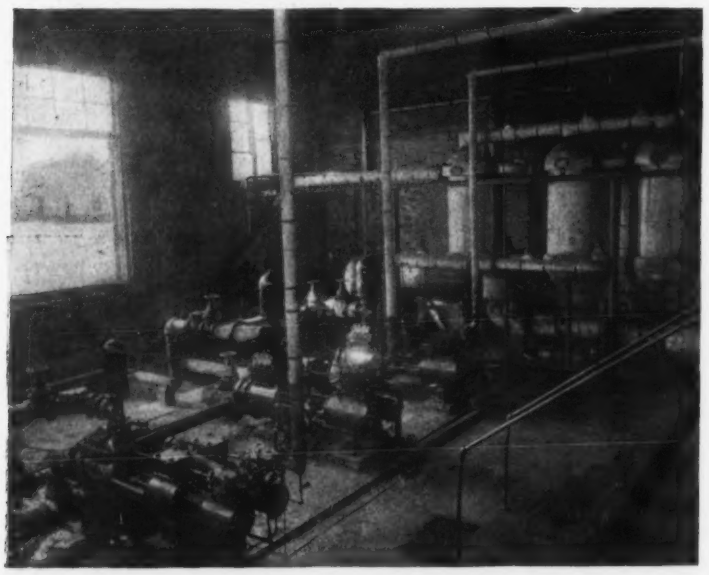


FIG. 4.—PUMP ROOM.

to the regular pumps. The hot-water pump connections are made to allow either one or both pumps to be used as the service requires. The suction is connected direct to one of the hot-water mains and the discharge pipes are connected to the other main through three Stahl closed condensers, each of 20,000 sq. ft. radiation capacity. Provision is made for the installation of a fourth condenser, and also for a connection through two circulating boilers, allowing one or both to be used as auxiliaries to the condensers when the exhaust steam from the engines and pumps is not sufficient to carry the heating load. A 2-in. steam line, carried from the boilers to each condenser, allows the use of live steam for this purpose when necessary. All exhaust steam is piped to the condensers through a 12-in. catch-all to remove all oil and grease. The condensation is returned by traps to the feed-water heater, and from there to the boilers. A 100-barrel cypress expansion tank is located just outside the building and connected directly to the suction of the hot water pumps.

Powers heat regulators are used by consumers to obtain a constant house temperature. To supply the necessary air-pressure for operating this apparatus, a small galvanized-iron air line is laid with the hot-water mains, and a constant pressure of fifteen pounds per square inch is held by locomotive-type Westinghouse air compressor equipped with an automatic governor.

Pipe covering is used on all live and exhaust steam piping, and all hot water piping and condensers. The entire plant has given satisfactory and uninterrupted service, and notwithstanding necessary extensions to the hot and cold water mains, is affording a very nice yearly dividend to the stockholders.

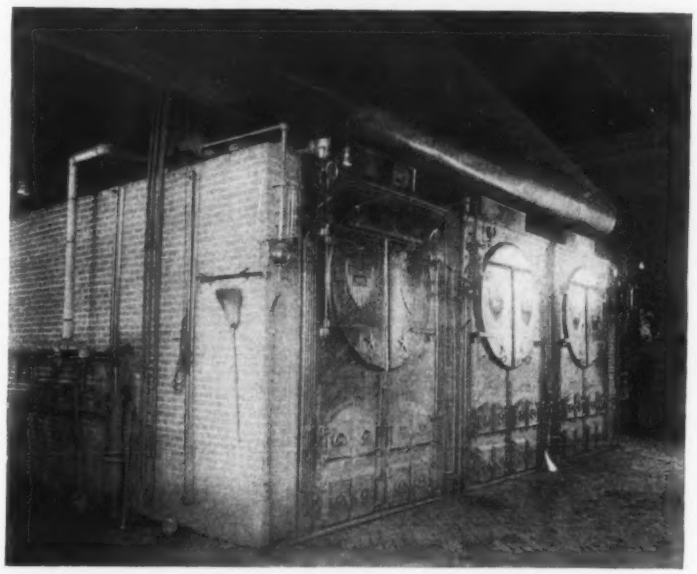


FIG. 5.—BOILERS.

To make a paying proposition of a plant of this description it is essential that a comparatively large day load be carried on the engines and pumps, as it is out of the question with prevailing rates to operate profitably the heating system with live steam or circulating boilers. The working up of a day motor load has been given close attention by Prof. B. S. Young, the general manager. The heating service has in every way been satisfactory to the consumers, and business is only limited by available exhaust steam.

Worm-Gear Traction Motors.

The Maschiner Fabrik Oerlikon has recently carried on an extensive series of tests employing worm gears with traction motors. Earlier experiments in this direction had proved unsatisfactory, principally because the worm gearing available at that time was not sufficiently well made to give a high efficiency, and also because, with the rigid connection between motor and gear which was employed, the shocks and consequent wear proved excessive. These difficulties have been largely overcome in the recent construction, and an experimental car containing two 20-hp, 1,200-revolution, worm-geared motors has given very satisfactory results. The motors weighed only 675 lbs., in place of 1,460 lbs. each, which would have been the case if ordinary single-reduction spur gear and 500-revolution motors had been used. The gear ratio was 12:1, the worm being of hard steel, with a triple thread having a pitch diameter of 3 in. and a pitch of 45 in., while the worm wheel had a cast-iron hub with phosphor-bronze toothed rim attached, a pitch diameter of 18.3 in. and 36 teeth. The motors were rigidly fixed to the car frame in accessible positions, and were connected to the worms through double flexible couplings, which allowed the necessary freedom of motion for the car springs. The worms and worm wheels are arranged on the outside of the car wheels, and run completely enclosed in oil baths. The end thrust is taken up on ball bearings. The gear was found to have an efficiency exceeding 90 per cent for all loads between one-fifth load and full load. The wear and the cost of up-keep proved to be less than with the ordinary spur gear, and the running was practically noiseless and free from shocks.

The Hoho Process of Heating and Working Metals by Electricity.

BY PAUL HOHO.

THE process described in this article was discovered about 12 years ago. Its most striking and almost paradoxical characteristic is that the metal is heated to temperatures corresponding to red heat, white heat and fusing heat while in contact with water. This is accomplished by the action of the electric current operating under specified conditions.

The author has often been called upon to explain why such a promising discovery has made so little progress in the industries as compared with other electric processes. Is this process condemned to remain without application in the industries? The object of this article is to endeavor to demonstrate that the answer to this question should be in the negative.

The process being well known, it is deemed unnecessary to give more than the following outline of its principal characteristics:

1. The electric energy is applied in the form of direct current at from 100 to 250 volts, these being the usual voltages available on commercial networks.

2. Owing to the relatively high e.m.f. as compared with other systems of electric heating, and the correspondingly weak current, this process permits the almost complete conversion of electric energy into heat right at the surface of the metal to be heated.

3. By proper application of suitable insulation, the heating action of the current can be confined to any desired portion of the surface in contact with the liquid.

4. By varying the e.m.f. it is possible to vary and regulate the quantity of heat liberated per second upon a given area. This permits the regulation of the final temperature and the speed of heating and makes it possible to attain excessively high temperatures in an extremely short time.

5. For any metallurgical operation the combination of the above-named properties makes it possible to heat exactly and exclusively any desired portion of the metal in a minimum space of time and consequently with a maximum efficiency.

6. When the metal is connected to the negative pole the electrolytic action of the current causes the deposition of the positive elements of the electrolyte upon the metal, i. e., initially the hydrogen released by the decomposition of water. In fact, the metal is heated in contact with a layer of hydrogen, which at high temperatures protects the metal from oxydation and moreover acts as a reducing agent if the metal was previously oxydized. The importance of this last property is great, especially where certain steels are to be soldered.

7. The rapidity of heating and the localization of the action obtained in this process and which cannot be obtained by any other known process, offers new and special applications; for instance, the surface tempering of steel. We shall return to this subject later.

The above-named properties were the cause of great hopes for the future of this process. A striking analogy may be cited which will immediately explain the situation. About a century ago gas was commercially employed as an illuminant, but it is not 50 years since it was first used in furnaces and it has not been used for heating dwellings for more than 10 or 20 years. The same will be true of electricity and for the same reasons, the chief among which being the cost of electrical energy.

In metallurgy, as in other industries, the cost of heat plays a most important part. We may, therefore, compare the price of one heat unit furnished by coal and by gas with that of one heat unit obtained from electric energy. A little calculation will serve to make the idea clear. In the process of combustion one kilogramme of coal will release about 8,000 calories, or $8{,}000 \times 425 = 3{,}400{,}000$ kilogramme-meters. When these calories have been transformed into electrical energy by means of the boiler, the engine and the dynamo, scarcely more than one horse-power-hour, or 736 watt-hours, is obtained, assuming a total efficiency of transformation above the average. 736 watt-hours $= 736 \times 3{,}600$ watt-seconds $= 2{,}649{,}600$ watt-seconds $= 2{,}649{,}600 \div 9.8 = 270{,}300$ kilogramme-meters. That is, the electric energy obtained from coal in the ordinary way represents scarcely more than 8 per cent of the original amount contained in the coal.

To this first cause of high price of electric energy must be added the expense which accompanies the transformations, the interest upon the investment, the maintenance, the depreciation, the personnel, etc. The final result is that electric energy is excessively dear, and even admitting a price of 1 cent per kw-hour, or 367,300 kilogramme-meters, or 866 calories, with coal at $3.20 per ton, the price of a calorie at the dynamo terminals is 29 times as dear as that obtained directly from the coal. Evidently these figures have no absolute value, since they depend upon the price of coal and that of electricity, both of which vary between wide limits. In fact, the price of coal varies from $2.40 in France to $5.00 or $8.00 and even more in other countries. The selling price of electricity varies between very large limits. Central stations furnish electricity for use in furnaces at 2 to 10 cents per kw-hour. No matter what source of energy is used, be it coal, gas, water or any other, the price of 1 cent per kw-hour is exceptional, and the proportion of the price per calorie of energy furnished directly by the coal and that obtained from the electric energy remains overwhelmingly in favor of the coal. A similar conclusion is reached when the price per calorie of energy furnished directly by gas is compared with that obtained from electric energy.

At first sight, from the point of view of cost, the competition of electricity with coal and gas seems impossible. However, the electric current possesses certain special qualities and properties, which, at least in many cases, will counterbalance the excessive cost.

Primarily, the electric energy, in the foregoing process, delivers the heat at the desired point and at a maximum efficiency. This is an immense advantage over its competitors, when there is taken into consideration the great masses of metal which are often uselessly heated. A short calculation will again make the point clear. In any operation where metal is to be heated, let the exact weight of the part to be heated, the temperature desired and the number of calories necessary, be given; i. e., the theoretical amount of heat necessary for the operation. Having these data the actual amount of energy consumed in the particular metallurgical operation can be calculated for the case where the heat is obtained directly from coal or gas. By this comparison the true efficiency is obtained. It is a fact that the thermal efficiency of a heating process by means of coal or gas is hopelessly small, oftentimes being less than a fraction of one per cent. For this there are three causes:

1. In order to heat the small portion of metal desired it is necessary to heat masses of metal of a much greater size.

2. In heating the metal by either coal or gas, all bodies which surround the fire must be heated with the metal. The furnace, the chimney and the products of combustion often absorb the major portion of the liberated heat.

3. In heating a few pieces of metal it is necessary that the furnace be hot for some time before and after the actual process.

On the other hand, this electric method permits the attainment of very fair efficiencies, which are vastly superior to those obtained by other processes. This high efficiency is due to the two following causes:

1. The restriction of the heat to the mass which it is desired to heat.

2. The rapidity of the action, which permits the reduction of the losses by radiation and conductivity to a minimum.

The efficiency depends upon the nature of the operation and the rapidity of the heating, and in certain cases an actual efficiency of 30 per cent has been obtained. This figure is unusual, but it serves to show the degree to which the perfection of this process can be pushed as compared with others.

The ratio between the efficiencies obtained by this process and that obtained by other processes varies greatly and depends primarily upon the nature of the metallurgical operation to be performed. It depends again on the kind of furnace used especially, the gas furnaces employed in large enterprises. But in any case this electric process gives an efficiency which vastly surpasses that of any other process. In certain cases it may be several hundred times greater, notably when it is necessary to heat small pieces of metal in furnaces which are ordinarily not in continuous use. On the other hand, there are many cases where the ratio of the efficiencies is not so great, namely, where metallurgical operations are conducted upon a large scale and large pieces of metal are heated in perfected furnaces which are in continuous use.

From that which has gone before it is readily seen that in metallurgical operations on a large commercial scale, the above-described process, as well as other electrical processes, cannot compete with coal or gas, at least in countries where coal is as cheap as in France. However, it has its use, namely, when the three following conditions obtain:

1. Small metallurgical operations, where it is not practicable to

install perfected furnaces and where power is obtainable at a reasonable price.

2. General metallurgical operations in localities where coal is dear and electrical energy relatively cheap.

3. In small installations where electricity is used for light and power, the attractiveness of substituting a vessel of water for the coal or gas furnace with its many disagreeable features will make its adoption a necessity.

Ignoring the possibility of radical discovery in electrical generation, it is a fact that the price of electric energy is continually decreasing, and each diminution in the price will enlarge the field of its application to the heating and working of metals. It should be borne in mind that when electricity has already been installed for other purposes its use for heating will reduce the price per kw-hour of the supplementary energy used in the heating process.

Such is the situation for the metallurgical operations of to-day as far as cost is concerned. It was mentioned above that certain special qualities of this electric process gave it, under certain circumstances, a special value and even new uses, which were formerly unknown.

In the first place, it will be recalled that the metal is heated in contact with a layer of hydrogen, i. e., in the middle of a reducing agent. This fact greatly favors certain operations, especially soldering, and even steels which are difficultly soldered by other methods can be easily soldered.

In the second place we find special uses which result from the localization and the control of the heat. The most important of these is that of surface tempering, which was mentioned above.

It may be assumed that a piece of steel, heated by the process in question, is in a liquid. The quantity of heat released per square centimeter of surface of the metal in contact with the liquid may be regulated at will; i. e., the rapidity of heating to a given temperature may be regulated. The liberation of heat can be so regulated that the steel will be brought to red heat, i. e., the tempering heat, a certain depth from the surface before sufficient time has elapsed to allow the heat to penetrate further into the interior of the piece, which is still cold for the moment.

If, at this instant, the circuit is opened the piece suddenly comes in contact with cold water, i. e., it is tempered, and it should be noted that only that part which was carried to the required temperature becomes hardened, while that part which was not heated remains tough and malleable.

The thickness of the hardened portion, i. e., that part which is brought to the temperature required for tempering, depends evidently upon the intensity and the duration of the heating, both of which may be perfectly controlled.

Any composition which it is desirable to use in tempering may be dissolved in the water. This surface tempering, which should not be confounded with case hardening was unknown until now and cannot be obtained by any other known process. The importance of this appears to be great, especially in the manufacture of rails, axles, shafting, cannons, etc.

At first thought the execution of this operation appears to offer insurmountable difficulties, due to the size of the pieces to be treated, which if tempered in one single operation would necessitate the employment of an enormous current. However, this difficulty is totally disposed of by employing a very simple remedy, which permits at any given instant the release of heat upon the surface of any predetermined portion of the metal in the water. This is accomplished by suitable insulators, in the form of two shields, which limit the action of the current to a sharply defined area on the piece of metal, and which are made to travel along the rail (for example) from one end to the other and expose each part successively to the heating action of the current for a time sufficiently long to allow the metal to reach the proper temperature and then passing on, leaving that part immersed in cold water. In fact it is possible to temper the head of a rail to any desired depth, without in any way affecting the malleability and toughness of the rest of the surface and the interior of the rail.

The surface thus heated, at any given instant, can be reduced to any convenient size, so that the tempering may be done with any desired current strength. It is evident that the time required for tempering the whole rail is inversely proportional to the power used. This same method applied to axles allows the tempering to be limited to the bearing surfaces. It may also be applied when tempering the interior surface of cannons.

The promotors of this process have an operating exhibit at the exposition in Liege, Belgium, where the successive heating and surface tempering of metals is presented to the public for the first time.

"Welfare Work" of the New York Edison.

The first meeting of the season of the American Institute of Electrical Engineers was held on September 22 at the new assembly rooms of the New York Edison Company on West 27th Street, where, with other technical societies, it will continue to meet until the completion of the United Engineering Building on West 39th Street, donated by Mr. Andrew Carnegie.

The new Edison building is one of the features of that company's

FIG. 1.—READING ROOM.

"welfare work" on behalf of its employees. The lower portion is occupied as a transforming station, while the upper has been designed as a library and reading room and assembly hall. The hall, holding between 400 and 500, occupies the top floor. The reading room is on the floor below.

The library will contain 1,000 volumes on technical subjects, interesting and instructive to the men. The floors are reached by

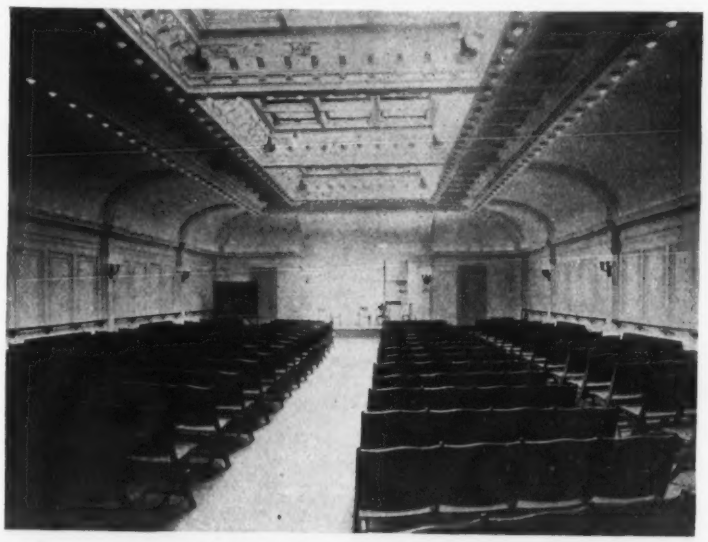


FIG. 2.—ASSEMBLY HALL.

electric elevators, and are equipped with everything that will add to the comfort and welfare of the employees. A striking feature is the method of lighting the rooms. The reading room is illuminated by the indirect arc method in which the light, first projected to the ceiling, is reflected to all parts; the auditorium combines the direct and the indirect, the former by incandescent lamps studding the ceiling and the latter by similar lamps concealed behind the cornice. There is perfect diffusion, without shadows—a near approach to daylight. The auditorium will be open to the various departments of the company for entertainments and lectures. Of the latter a number will be given by experts eminent in the various fields and on subjects in which the men are most interested.

Thermodynamics of the Electric Incandescent Lamp.

With the above title, Dr. E. F. Roeber presented a paper at the meeting last week at Bethlehem, Pa., of the American Electrochemical Society, during the reading of which the several new types of incandescent lamps—osmium, tantalum and graphitized filament—were exhibited in operation.

The subject was treated with relation to the thermodynamics of radiation from an incandescent body. A lamp consisting of a conductor of the first class—that is, a filament conducting as a metal—enclosed in an absolute vacuum, was assumed. The following equation connecting the supply of electrical energy to the lamp, with the total radiation was then established, on the assumption of a black radiating body:

$$\frac{e^2\gamma}{2} \cdot \frac{r}{l^2} = K\,(T^4 - T_0^4), \qquad (1)$$

where e = volts at terminals, γ = conductivity, r = radius of filament, l = length of filament, T = absolute temperature of filament, T_0 = surrounding absolute temperature, K = Stefan-Boltzmann radiating constant. This equation enables the temperature of the filament to be calculated if e is known, and if the filament behaves as a black body.

The total radiation consists of electromagnetic waves of an infinite series of different wave lengths, but the physiological effect of light is produced on the normal eye only by those waves the length of which is between 8×10^{-5} and 4×10^{-5} cm., corresponding to a frequency between 39×10^{13} and 76×10^{13} periods per second. The desideratum is such a spectrum of incandescent filament radiation that as much as possible of its area falls within the limits of the wave lengths of visible light. It is shown that a first indication of the degree to which this desideratum is fulfilled is given by Wien's displacement law, according to which the product of the wave length, λm, of maximum energy and the absolute temperature, T, of the radiating source is a constant.

$$\lambda m\, T = \text{constant}. \qquad (2)$$

If the wave length λm is measured in centimeters, the constant is 0.2940 for a black body. If, therefore, the temperature of the incandescent filament increases, the maximum of energy is shifted toward shorter wave lengths. In order to get the maximum energy within the visible spectrum, for instance at the wave length 6×10^{-5} cm. not far from the D line of sodium, the absolute temperature of the black body filament must be 4,900° absolute, or over 4,600° C. This is far beyond anything we can ever hope to reach in incandescent lamps.

The spectral distribution of energy in the radiation of a black body is given by another Wien's law, which, as modified by Planck, is given below, where J is the energy corresponding to the wave length λ in the spectrum, T is the absolute temperature of the radiating black body, ϵ is the base of the natural system of logarithms, and C_1 and C_2 are constants.

$$J = C_1 \lambda^{-5} \frac{1}{\epsilon^x - 1}. \qquad (3)$$

where $$x = \frac{C_2}{\lambda T}.$$

This equation has been found to represent in a most remarkable way the facts throughout the extreme ranges in which it has been tested. These formulas represent the fundamental laws of the radiation of a black body.

It would, of course, be possible to calculate from Planck's law the exact distribution of the energy in the spectrum of a black body at any given temperature, or to calculate from this law the temperature at which the energy within the visible spectrum becomes a maximum. This would give the temperature for which we would get the highest possible efficiency of a black-body filament incandescent lamp. However, no attempt was made to give this calculation, for two reasons: First, from Wien's displacement law it has been found approximately above that this temperature is very high, beyond anything we can hope to reach in practice. Secondly, it will be seen later on that a black-body filament is really not the goal to strive at, in incandescent lighting.

In practice the efficiency of a lamp is not given as the ratio of the energy of radiation within the visible spectrum to the total radiation, but is given by the candle-power which is produced by one watt, or what is the more general, although improper usage, by the reverse ratio, i. e., the number of watts consumed per candle. The rays within the visible spectrum form what we call the flux of light and their energy is sometimes assumed to be measured by spherical candle-power.

The underlying idea is that the spherical candle-power is proportional to the energy of the light emitted. Now, as long as we have to do with light of one single wave length this supposition is correct. But if we compare two composite sources of light, the element of the physiological effect enters into the measurement of the candle-power, since the intensity of the physiological effect depends on the wave length. On the other hand, the energy of light has a distinct value independent of whether it produces any physiological effect or not.

It is, therefore, strictly correct only with monochromatic light to assume the candle-power to be a measure of the energy of visible radiation; and for this reason it is proper only for single wave lengths to try to find a numerical relation between spherical candle-power and the usual units of power—or as we may say, the mechanical equivalent of light.

Since the physiological effect on the normal eye is a function of the wave length, the relation between candle-power and other units of power must also be a function of the wave length. Nevertheless, in practice we compare different sources of light—of different spectral composition—by their candle-power. In such cases we average the physiological effects of the energies of the different wave lengths.

The results obtained by experimental determinations of the mechanical equivalent of light must, therefore, if not limited to a single wave length, be taken *cum grano salis*, although they undoubtedly are interesting as giving a first approximation to the truth.

Experimental researches on this problem seem to have been made first by Julius Thomsen and O. Tumlirz. The result of Tumlirz was 0.188 watt per spherical hefner candle-power. However, his method of measurement was open to objections, since he separated the visible spectrum from the other rays by trying to absorb the latter in a layer of water. This must lead to too high a numerical value of the watts per candle, as was more recently pointed out by Angström, who made another determination of the mechanical equivalent of light. In order to separate the visible spectrum from the balance of the spectrum, he decomposed by refraction the total radiation into the rays of different wave lengths, cut off all rays except those within the visible spectrum and recombined the latter by means of a lens. His result appears to be the best available at present.

Angström found that the equivalent of the light radiation of 1 hefner candle per square cm at a distance of 1 meter (1 candle-meter) is 8.1 ergs per second. This gives as the equivalent of 1 spherical hefner candle 0.102 watt. This is only about one-half the equivalent of Tumlirz.

Now 1 spherical hefner = 0.88 spherical (British) candlepower. We, therefore, get as the result of Angström's determination, for 100 per cent efficiency, 1 spherical candle-power = 0.115 watt; or 1 watt = 8.63 spherical candle-power.

One of the most efficient new types of incandescent lamps, the tantalum lamp, consumes initially 1.99 watts per mean horizontal candle-power, and 2.78 watts per mean spherical candle-power; while the average value throughout life was found as 2.19 and 2.70 watts, respectively, according to recent tests made in a testing laboratory in this country. For the efficiency calculation the watts per spherical cp must be chosen, and if we base this calculation on 2.70 watts and on Angström's equivalent, it follows that the tantalum lamp has an efficiency of 4.3 per cent. An ordinary carbon filament incandescent lamp, if consuming 3.1 watts per mean horizontal cp and 3.9 watts per mean spherical cp, has an efficiency of only 3.0 per cent.

The author referred in this connection to the question of mean horizontal versus mean spherical candle-power. It is still a general rule in this country to rate incandescent lamps (with the exception of the Nernst lamp) by mean horizontal cp, although the impropriety of this method is clearly recognized. The American Institute of Electrical Engineers has already formally declared itself in favor of rating on the basis of mean spherical cp. This is obviously the only proper method of comparing the light given out by different types of lamps with each other.

But even in the test of a single lamp, the curve giving the change

of horizontal candle-power during life does not represent a true indication of the performance of the lamp. In testing the horizontal cp one unconsciously makes the supposition that the reduction factor (by which the mean horizontal cp must be multiplied to get the mean spherical cp) remains the same during the whole life. But, as a matter of fact, this is not the case. The distribution of light in a vertical plane changes during life, and with it changes the reduction factor.

This was very clearly shown in the tests of the tantalum lamp above referred to. In this case a black band formed during life on the globe around the sides of the bulb and about an inch wide, which materially decreased the horizontal cp.

As to the problem: What can be done to make incandescent lamps more efficient? One obvious conclusion from the above discussion is, that if we are confined to a black-body filament we must increase the temperature of the glowing filament very materially.

The carbon filament of the old ordinary incandescent lamp has often been assumed to come pretty near a black body. Now, it will at once be seen, that we can easily increase the voltage temperature, T, of the filament by increasing the voltage, e; equation (1) gives the exact variation of T with e. If we do this, the maximum of energy in the spectrum will be shifted towards shorter wave lengths according to (2); i. e., the light gets better, whiter, more like sunlight in spectral composition. As a necessary concomitant, the area of the energy curve, which falls within the visible spectrum, increases; in other words, the efficiency increases.

It can be laid down as a general rule that the color effect of the light of an incandescent lamp enables one to judge approximately the efficiency at which it burns. The reason is, that according to the above theory, both the color effect and the efficiency are functions of the temperature. Dr. Louis Bell gives the following color scale of efficiencies of ordinary carbon filament incandescent lamps. Naturally, these are only approximations, since one's judgment is so liable to be warped by the bluish tint of ordinary daylight, owing to reflected sky light that the color values of artificial light are very difficult to judge:

Watts per c. p.	Color.
1.5	clear white
2.0 to 2.5	white, very faintly tinged with yellow
3.0	yellowish white
3.5	yellowish
4.0	yellowish, tinged with orange
4.5	orange yellow
5.0	distinctly orange red

Lummer refers to a test of a lamp of 16 spher. cp which, when burned at 45 volts gave 16 cp, thus consuming 3.5 watts per spherical cp; the voltage was raised, and with it the electrical energy supplied to the lamp to 285 watts; simultaneously, the candle-power increased to 2,000 cp, representing a consumption of 0.13 watt per spher. cp (which is almost the theoretical limit, according to Angström's equivalent). Thus an increase of energy in the ratio from 1 to 5 corresponds to an increase of cp from 1 to 130 and to an increase of efficiency from 1 to 26.

But, of course, the highly efficient state lasts only a moment. This brings us to the point of life. We must make, in practice, a compromise between a reasonably long life and a reasonably high efficiency. There must be an economic relation between life of lamp, cost of lamp and cost of energy.

Moreover, a very important forward step in the manufacture of the carbon filament lamp was the recognition of the importance of differentiating useful life from actual life. This is due to the continual decrease of candle-power of the lamp, setting in shortly after starting, accompanied by an increase in the consumption of watts per cp. It is now considered proper to "oslerize" a lamp when its candle-power has decreased to 80 per cent of its initial value.

The decrease of candle-power at constant voltage which determines the useful life of the carbon filament lamp is known to be mainly due to three causes: First, an increase of resistance, resulting in a diminution of watts; second, a change in the surface activity of the filament, resulting in a diminution of emissivity; third, diminished translucency of the globe, due to the well known black deposit which forms on the globe. A possible explanation of the second effect will be discussed later. Concerning the third effect, it may be said that it is usual to speak of evaporation of carbon. The speaker doubted whether it has ever been proven that such evaporation really takes place. It is quite possible that minute small solid particles of carbon are thrown off from the filament. It is a fact that the carbon is mainly given off near the negative extremity of the filament. Chemical analysis of the black deposit in the case of lamps with flashed filament have shown that the deposit consists partly of carbon and partly of hydrocarbons.

According to Marshall, 16-cp carbon filament lamps can be made according to the following table:

Useful life in hours	28	132	412	1,000	2,005	3,570	6,125
Watts	32	40	48	56	64	72	80
Watts per cp	2	2.5	3.0	3.5	4.0	4.5	5.0

What type to select depends on the relative cost of the lamps and of the electrical energy.

The author then returned to a discussion of possibilities of improving the efficiency. If a black-body filament is to be used, the progress must be looked for in an increase of its temperature. This is the reason of experiments with metals of very high melting points for filaments, such as osmium in Dr. Auer von Welsbach's osmium lamp, since osmium has the highest melting point of any known metal. The same principle was followed in the systematic development of the Siemens & Halske tantalum lamp by Dr. von Bolton, who tried the following metals one after the other: Vanadium, niobium, tantalum. Their melting points are 1,680°, 1,950° and 2,250 to 2,300° C., respectively, and on account of its highest melting point tantalum was finally chosen. The underlying idea is that a filament made from a material of very high melting point will stand without injury a high temperature during a reasonably long life. In this connection it is important to use pure materials, since any small addition of a foreign material lowers the melting point. Thermo-dynamically this is the same effect as the lowering of the freezing point of water, when salt is added. The necessity of using both high temperatures and pure materials indicates the need of employing electrochemical methods.

However, by simply increasing the temperature we cannot get very far towards the realization of the ideal if a black body filament is used. We saw before, that according to Wien's displacement law, we would need to use a temperature of more than 4,600° C., i. e., more than 8,000° F. to get the maximum of energy at 0.6 μ. There is no hope of coming near such a temperature in present practice.

But, fortunately, there is no necessity whatever to use a black body filament. A black body is an ideal case in thermodynamics; it is nowhere strictly realized in practice, but it is now absolutely within the grasp of the mathematical physicist. But the black body is not at all the ideal thing for the lighting engineer. On the contrary, we will see the further we can get away from the black body, the better for us.

The above discussion was based on the consideration of the black body filament because on this matter we can speak with certainty and without vagueness. The discussion of filaments departing from black-body radiation can be carried out only in special cases with similar mathematical exactness. In general, we must be satisfied to indicate the direction in which the results will vary from black body radiation.

At a given temperature the total radiation from a non-black body is less than from a black body. Hence, if we substitute a non-black-body filament for the black-body filament, leaving everything else unchanged, the fundamental equation (1) will no longer be valid. The stationary condition, represented by the equality of radiation energy and electrical energy supply, necessitates now a higher temperature, T, than with a black-body filament.

Of greater importance, however, than the total radiation is the distribution of the energy of radiation over the whole spectrum. Non-black body radiation is essentially selective radiation. The real ideal thing about the black body is that, according to definition, its radiation is not selective, since it absorbs all rays of any wave length and, therefore, according to Kirchhoff's law of the parallelism between radiation and absorption, it also radiates all of them.

The ideal filament for the lighting engineer must be one which absorbs only rays within the visible spectrum, while it either perfectly reflects all other rays or is perfectly transparent for the same. Such a body would then emit a radiation completely within the visible spectrum.

It serves no useful purpose to speculate, whether we have any prospects to realize such an ideal filament body. Instead, the author briefly stated what we know concerning polished platinum, which is one of the bodies which of all those tested show the greatest departure from a black body.

In Wien's displacement law (2) $\lambda m\, T$ = constant, the constant is 0.2940 for the black body and 0.2626 for polished platinum (Lummer and Pringsheim), when the wave length is measured in cm. Hence the absolute temperature, T, at which the maximum of energy lies at a certain wave length, is less by about 10 per cent with polished platinum than with the black body. This means that heated to the same temperature, a polished platinum filament will have a spectrum with its maximum of energy nearer to the visible spectrum than a black-body filament. Nevertheless, polished platinum is still very far from the ideal material which the lighting engineer must aim at.

No rule can be laid down how to select or devise such an ideal material, except to determine empirically the absorption of all possible substances for all different wave lengths. However, the degree of departure of a body from black-body radiation does not depend solely on its material, but also depends to a certain degree on the condition and the configuration of its surface. The more porous the surface the more will it behave like a black body.

The realization of the black body in practice is based upon Kirchhoff's fundamental rule that the radiation inside an inclosure all points of which are kept on uniform temperature is absolute black-body radiation. The black body with which the laws of radiation have been experimentally established is such a hollow enclosure, the walls of which are kept on uniform temperature but contain a small opening through which the radiation is observed. The presence of the opening represents a negligible departure from absolute black-body radiation. Further, in pyrometric practice, "If a porcelain tube with closed bottom be immersed into a lead-hardening bath, the radiation coming from the bottom of this tube will be a close approximation to that of a black body, especially if the inside of the tube is blackened with iron or nickel oxide, for example." (Waidner and Burgess.)

Now it is evident that any pore in the surface of an incandescent filament, whatever it is made of, will cause a behavior more or less like black-body radiation. Hence, we get the important result that the ideal filament must have a polished surface without pores. Blau has called attention to this point in connection with the osmium lamp.

In the case of the osmium lamp it has been noticed that the initial increase of cp after the current is turned on, which is observed with almost every filament, continues for an unusually long period, somewhat like 200 hours. This is said to be due to a continuation of the formation of the filament, the particles being better fused together and the surface getting more polished. It is quite possible that in the case of the new graphitized carbon filament of the General Electric Company something similar goes on, since the treatment is essentially an external surface treatment, although the material of the filament itself is changed.

While speaking of the ordinary carbon filament it was noticed above that two of the reasons of the ageing of the lamp were decrease of surface emissivity and a throwing off of carbon particles from the filament with a resulting blackening of the globe. These two effects have generally been considered to be independent of each other, although in the light of the above discussion it may be that the decrease of emissivity is due to the formation of pores or minute holes in the surface of the filament, as a result of the throwing off of small carbon particles. If this is true, the negative terminal of the filament (from which the carbon particles are mainly thrown off) should lose more in emissivity than the other terminal. To test this suggestion it would be necessary, of course, to separate carefully the effect of change of emissivity from the effect of blackening of the globe. For this reason the globe would have first to be uniformly cleaned, before the emissivity of the two ends of the filament should be compared.

Dr. Roeber then showed, connected in circuit, the several new types of incandescent lamps—the tantalum and osmium lamps and the graphitized carbon filament lamp made by the General Electric Co. and invented in its research laboratory under the direction of Dr. W. R. Whitney.

Concerning the manufacture of the tantalum lamp Dr. von Bolton gives the following information: He first mentions the experiments of Berzelius and Rose. They produced tantalum by heating the potassium and tantalum fluoride (K_2TaF_7) with potassium, and extracting the potassium fluoride with water; this method, however, does not yield pure metallic tantalum, but a product containing only about 5 per cent of the pure metal. Moissan described in 1902 the production of tantalum in the electric furnace by reducing the oxide with carbon; but the product contained about 0.5 per cent carbon and was, therefore, either a carbide (0.5 per cent C. being a pretty large quantity in view of the high atomic weight of tantalum) or it was an alloy of the metal with carbide. Von Bolton describes briefly two methods of producing pure metallic tantalum.

The first method is electrolytic reduction of one of the oxides in the incandescent state in a vacuum. He formed filaments of brown tantalum tetroxide and placed them in vacuum. By passing the electric current through, they were caused to glow slightly, whereby much air was driven out of the porous filaments. Evacuation was then continued and the temperature of the glowing filament was increased until, at beginning white heat, several points of the filament showed strong incandescence. These points gradually extended to longer and longer lines, until the filament was incandescent uniformly along its whole length. During this reaction much gas was given off, which was identified as pure oxygen. The brown color of the original oxide had changed into pure metallic gray, and the wire had become flexible after several hours of strongest white incandescence, like a wire of copper.

The second method, which is the most practical one, is to produce tantalum by the method of Berzelius and Rose, mentioned above, and then to purify and refine the metal in the vacuum under the action of the electric arc. This method is based on the fact that the oxides of tantalum melt more easily than the tantalum itself, and on the other fact, that they are much more easily volatilized in a vacuum than the metal, so that the metal can be completely separated from the oxide.

Concerning the manufacture of the filament of the osmium lamp the latest information is given by Blau. The raw material is very finely divided osmium, which is mixed with organic binding materials so as to form a thick, tough paste, which is pressed under very high pressure through an aperture. A thread is thereby obtained which is formed into loops. The threads are then dried and are heated in the absence of air in order to carburize the binding material, and then subjected to the most important process, which is called formation. The threads which now consist of porous rough osmium with a high content of carbon are heated for a long time by means of an electric current gradually to a higher and higher temperature up to white heat in an atmosphere which contains very much steam and smaller or larger quantities of reducing gases. The carbon is removed by the same reaction which takes place in the production of water gas, and the filament thus becomes pure porous osmium of a far greater density than the former rough thread. During the first period of the use of the lamp the osmium surface becomes gradually smoother and more polished; this accounts for an increase of the light given out by a lamp during this period.

Concerning the manufacture of graphitized carbon filament of the General Electric Company, the fullest information is contained in the paper of John W. Howell, ELECTRICAL WORLD AND ENGINEER, June 24, 1905. The main point is an external surface treatment of the filament in an electric tube furnace.

It will thus be seen that in the development of all three new lamps. electrochemical methods have proven of enormous importance. The speaker pointed out that it would be extremely interesting to know how far the progress achieved by the new lamps is due to the increased temperature and how far to a greater departure from black body radiation. We know of all three lamps that their filaments are at higher temperature than the ordinary carbon filament. Concerning the question, however, how far the three new filaments (in comparison with the ordinary carbon filament) depart from the black body, no information of an exact nature has apparently been published.

A complete investigation of these problems would involve not only a determination of the actual temperatures and of the "black body temperatures" of the filaments, but the actual distribution of the energy within the spectrum.

This would give us directly the absolute efficiency of the three lamps as the ratio of the area within the visible spectrum to the area of the total spectrum of the energy curve. It is quite possible that the numerical value of the efficiency, thus determined, may differ essentially from the efficiency, as determined from the cp per watt on the basis of the mechanical equivalent of light.

The first definition is absolutely physical and leaves the physiological aspect of the problem out of consideration; in this definition each watt corresponding to one wave length within the visible

spectrum is considered as perfectly equivalent to one watt corresponding to any other wave length within the visible spectrum, although the physiological effects may be very different. The second definition of efficiency, on the other hand, is essentially based on the physiological effect. According to the second definition the efficiency of the osmium lamp is about twice that of the ordinary carbon lamp; but this does not necessarily mean that the efficiency according to the first definition has also been doubled. For the actual efficiency the loss of heat by conduction through the leading-in wires is also a factor; this has not been considered in the above discussion.

The speaker concluded that, in spite of what has already been accomplished, we are still far from finality, and he expressed the hope that the progress made in electrochemical methods during the last decade will continue to react on the invention of incandescent lamps in an encouraging and helpful manner, as has already been the case with the osmium, tantalum and graphitized filament lamps.

Recent Electrochemical Development.

ELECTROLYTIC PROCESSES.

It is generally very easy to arrange an electrolytic cell so that at the moment when operation is started exactly those products are obtained which are wanted. But in very many cases difficulties arise afterwards. These are due to the fact that by the electrolytic action the constitution of the system itself is changed. Such an effect may manifest itself in various ways. For instance, as a result of the electrolytic action some new material may get into the electrolyte and then act as an impurity; it may participate itself in the electrolysis, and produce new undesired effects. To prevent this, a patent, recently granted to Carl Hering, proposes to remove such "objectionable" elements by catching them as insoluble compounds formed with one or the other electrode. The material of the electrode must be chosen according to the nature of the objectionable element to be removed. It may be that this element is objectionable only in so far as it would produce undesired effects if left in the electrolyte, but it may be otherwise valuable. In such a case it may afterward be recovered by removing the electrode with its insoluble salt from the cell and using it as an anode in another cell if previously it was the cathode in the first cell, or using it as a cathode in the second cell if it had been the anode in the first cell.

As an instance, the electrolytic recovery of zinc from zinc sulphate may be mentioned. If this is carried out with an inert electrode, sulphuric acid is formed at the anode This will then participate in the electrolysis with the result that hydrogen is set free at the cathode, and the efficiency of the deposition of zinc is decreased more and more the further the electrolysis proceeds. To prevent this it is evidently sufficient to catch the SO_4 ions when being discharged in the form of an insoluble salt at the anode. This is possible by means of a porous lead anode which changes into lead sulphate according to the reaction well known from the lead accumulator. Another application described in the patent of Hering is the recovery of both zinc and acid from discharged primary cells. The free acid is first extracted by using a sponge lead anode and a lead peroxide cathode. Then the solution is electrolyzed between a cathode of mercury, zinc, etc., for receiving the zinc and an anode of spongy lead.

In a patent recently granted to Carl Kellner attention is called to the fact that in certain cases solid metallic plates as electrodes may have an unnecessarily large surface. This large surface may have the disadvantage of unduly accelerating undesirable secondary reactions; thus, in the electrolytic production of bleaching liquor, all particles of hypochlorite in contact with the cathode are again reduced. For such purposes Kellner uses electrode plates of glass or celluloid around which a helix of platinum wire is wound. Any number of such plates are placed one after the other in a cell. The portions of wire on one side of the glass plate act as anode, those on the other side as cathode.

G. J. Atkins has recently patented details of construction of an electrolytic cell, in which the cathode is a revolving drum, while the anode is the concentric carbon lining of the trough. This carbon lining forms an almost closed cylinder around the drum. The revolving drum is completely immersed in the electrolyte.

A recent patent of C. F. Blacklidge relates to electrotyping. The mold of wax is first coated with an alcoholic substratum of collodion on which a film of silver is precipitated. This is then plated electrolytically with nickel.

C. von Portheim has recently patented a method of obtaining glyoxalic acid, its esters and anrids from compounds containing the radical oxalyl (C_2O_2) by cathodic reduction.

A recent patent of L. Potthoff refers to mechanical details of construction of a tank for electroplating bars, tubes, and in general, such articles which are too large to be shaken up, as is done with small nails, etc. The tank contains a traveling band with a series of cathode tormisants adapted to move the articles to be galvanized, while means are provided for automatically changing the point of contact between the articles.

STORAGE BATTERY INVENTION.

W. Gardiner has recently patented the following construction of the grid for lead accumulators. A sheet of lead is rolled down very thin and thoroughly perforated. It is then folded transversely into a great many plates and is afterwards formed electrolytically. A recent patent of A. E. Knight relates to mechanical details of construction of storage battery plates, the main object being to prevent buckling or warping.

MISCELLANEOUS.

The extended researches which have been made in recent years on electric discharges through gases, especially through air, have resulted in several interesting industrial developments. While the most-talked-of problem, that of producing nitric acid from air, is still decidedly in the experimental stage, yet there are now industrial uses of similar processes in connection with sterilization of water by ozone and with bleaching flour, etc. A recent patent of A. Johnson is an indication of the activity in the last line. It refers mainly to details of construction. The main point is that air is sucked into the "generating chamber," and through continuous electric arc, by which "it is decomposed and converted into gases suitable for use in bleaching flour."

A recent process of J. F. Lester for the purification of water is a combination of electrolytic purification, with sterilization by means of ozone. The apparatus contains an electrolytic chamber (in which the electrodes act simultaneously as baffle plates),. an ozonizing chamber, and a filter in a single casing. The electrolytic chamber and the ozonizing chamber are totally surrounded by water to prevent the heating of the water being treated.

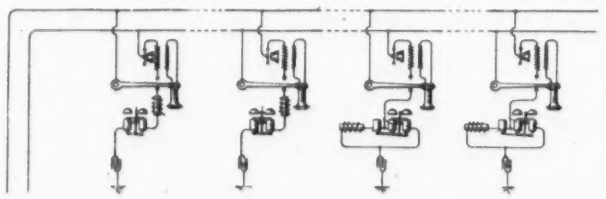
In straining certain liquids it is desirable to heat them while they are passing through the strainer. For this purpose W. J. Morrison uses a strainer made up of a series of contiguously arranged sections of non-absorbent insulating material in which a suitably-controlled electrically-heated conductor is embedded.

New Telephone Patents.

FOUR-PARTY SELECTIVE SYSTEM.

A new four-party selective system has been invented and patented by O. M. Leich, of Chicago. This, like many of its predecessors, makes a distinction between the two sides of the line, all ringing being done with earth return. This method reduces the required number of types of station to two.

Mr. Leich bases his selection entirely upon the counteracting effects



LEICH SELECTIVE SYSTEM.

of capacity and inductance. To this end he makes one station insensible to ordinary alternating currents and the other sensible to them. This result is accomplished by using an ordinary winding for one station and for the other an inductance such that the usual alternating current is effectually blocked off.

In order to ring this latter station the inductance must be neu-

tralized. This is accomplished sufficiently by placing at the central office associated with the proper ringing key a condenser, through which the current must pass. The leading current from this circuit combined with the lagging effect produced by the high inductance, leaves a current sufficient to produce results at the bell. As thus far explained it would in fact affect both stations and means must therefore be provided to render the regular bell insensible to this current. This locking is accomplished by an armature extension which moves in the magnetic influence of an auxiliary coil. This coil is in series with a high inductance, the whole being in parallel with the ringer. A light pull on the armature extension will lock a considerably stronger pull from the ringer coils. The leading current in the high inductance lock circuit exerts the required pull, while the phased current does not.

PARTY-LINE KEY.

Mr. M. Setter has invented a new four-party line switching k[illegible] the patent for which he has assigned to the American Electric Telephone Company, of Chicago. With this type of key each elemental key should lock after depression until released by the depression of one of the other elements. This has heretofore been successfully accomplished by magnetic means, but Mr. Setter's arrangement is wholly mechanical, a series of latches being provided beneath the plungers, all linked together to act synchronously. If any key be depressed, the latches are tilted to release position first and then, as the actuating element is pushed home, the latter snap back under spring pressure to "locking" position.

SWITCHBOARD.

A return to first principles has certainly been made by E. H. Strauss, of Chicago, who has patented a plug and bar switchboard for telephone work which is not far different from the old telegraph type boards which telephony originally fell heir to. It is difficult to see what is to be done with it at this late date.

REPEATER.

Mr. D. H. Wilson, of Chicago, has devoted his energies to a repeater which he has recently patented. In this the circuit is led through a split-wound coil, whose core is confronted with two diaphragms, one at each end. These actuate transmitters whose common circuit includes reinforcing winding laid over the split receiving winding.

LETTERS TO THE EDITORS.

The Use of the Third Person in A. I. E. E. Discussions.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with interest the communication of Mr. Behrend in your issue of Sept. 9 regarding the use of the third person in the discussions of the A. I. E. E. as they appear in print. Also your editorial explanations of the reason for this usage, and Dr. Hutchinson's further communication on the subject in your issue of Sept. 23.

That this method of reporting the discussions of the Institute was adopted for reasons which appeared wise at the time, no one questions. That whatever these reasons might have been, the method has failed obviously and deplorably is equally beyond question. The advantage of the adoption of the third person, is, apparently, to shorten the printed discussions. That the two words "The speaker" are shorter than the good old pronoun "I" is still a source of wonder to me, and the way in which brevity is served by the change is not manifest. Its ambiguousness is further a reason for its unsuitability. "The speaker." What speaker? The one presenting the paper under discussion; a previous speaker in the discussion or the speaker then expressing his views and experiences? Whatever may have been the reasons for the adoption of the third person, to the casual observer, it looks like an affectation that borders on cheap pedantry. These views are expressed the more unhesitatingly because of their having been so frequently and forcibly—indeed profanely—confirmed by numerous members, officers, and associates of the Institute. Indeed there are some members, whose sensitiveness in the matter of being represented as reasonable and logical humans, in printed documents which may come under observation of scientists and litterateurs, is such that they refrain from participating in discussions, which may after appear in such public form as to lead to the belief that they were really guilty of expressing themselves in so ridiculous a manner. Dr. Hutchinson states, in effect, that about 90 per cent of the discussions should be suppressed, being useless and irrelevant. If any discussion come in this class it should, of course, be deleted, but just what bearing the use of the third person has on the suppression of discussions is a little difficult for the ordinary intelligence to fathom. The essence of Dr. Hutchinson's statement is, that the use of the third person would be proper and helpful, if the Institute had at its command sufficient money and assistants to properly edit the papers, and the present similarity of the printed discussions to a joke book, he attributes to the inability of the Institute to properly handle this cumbrous pronominal. In other words, the Institute has attempted to do something which it has neither the means nor ability to accomplish; a serious reflection on a body of engineers. Our curiosity is greatly aroused over Dr. Hutchinson's statement that only one member of the Institute utters remarks that are fit for print without revision. We wonder who it can be and are now lost in speculation.

The general sentiment of the Institute, so far as I have heard it expressed, is, that the use of the third person is objectionable, and it should be abandoned forthwith. I, for one, desire to express my unalterable opposition to it, and trust that a rational method of editing, the successful execution of which is within the means and power of the Institute, may be substituted for the present practice.

NEW YORK CITY. LAMAR LYNDON.

[That objection to the use of the third person in editing discussions, which is based upon the literary difficulties involved can be dismissed with the remark that other societies have overcome these difficulties, and that editors the world over constantly practice the art of condensation in the third person with no thought that they are performing a literary feat. The issue thus appears to resolve itself into whether the *Transactions* of the Institute shall be held to their proper function of recording technical information, or only partly devoted to this object and partly given over to the exploitation of individualities—or persons, to use a plainer term. We fear that Mr. Lyndon has taken for the "general sentiment of the Institute" the sentiment of those whose remarks have been edited, which may easily differ widely from the sentiment of the 3,500 or more members of the Institute who merely read the *Transactions*.—EDS.]

"Made in Germany."

To the Editors of Electrical World and Engineer:

SIRS:—On page 489 of your issue of Sept. 16, under the heading of "Electricity in Agriculture," Mr. E. W. Baker, of Barry, Ill., directs attention to the slow progress in the United States in the adaptation of electricity to agriculture, while in other countries, notably Germany, rapid advances have been made. Mr. Baker states that from 1893 to 1901 he has searched the index of the ELECTRICAL WORLD AND ENGINEER for notices of electric plowing, and found many references, but all to "trials made in Germany," and concludes: "I think it is high time that this odious German label should be removed in a branch of applied science where otherwise we Americans stand first."

Mr. Baker seems to be not well acquainted with what is going on in the technical world, as otherwise he would have discovered that these machines are all made in Germany, and while I appreciate the work and pains he has devoted to looking up the subject, I do not know of any branch where the "odious phrase" "made in Germany" is more appropriate than in applied science. This is not only true of electric agricultural machinery, but it has long been known by many engineers, although not generally recognized, that much of modern machinery where science is applied is invented or developed by the Germans, though not bearing this label. It will probably surprise Mr. Baker to be informed that alternating-current railroading, high-speed electric traction, high-tension oil switches, superheated steam practice, the newer type of large gas engines, reinforced concrete, steam turbines, etc., all emanate from Germany. It will probably be quite a surprise to Mr. Baker to learn that the very type of water wheel by means of which he proposes to harness the western waters is also a German invention, although it also does not bear the "odious" label.

That Germany is a country of pioneers in applied science may be largely due to the patience and thoroughness with which her engineers experiment. To this must be added credit to the German government which supports them generously. Mr. Baker is certainly on the right road in criticizing the government—that is just what Bismarck taught the Germans to do—but the German government adopted a better scheme than that suggested by Mr. Baker, some dozen years ago when America was ahead of Germany in agricultural machinery. Germany opened its doors for the importation of this machinery and at the same time its engineers were sent to this country, receiving government assistance, to study American industrial methods. Who knows but that Mr. Baker is of the same opinion, as a worthy cousin of Germany who once said, "When Germany is destroyed and its commerce killed, every Englishman will be one-third richer than he is now."

NEW YORK CITY. FRANZ KOESTER.

Central Station Rates.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with interest, in your issue of Sept. 9 last, the editorials entitled "The Small Power-User" and "Central Station Rates," but do not think I can agree with you that "there has been in recent years a growing disposition to make rates for the benefit of the large user," nor that the Central Station "often arranges so-called service charges or maximum demand charges in a way to still further aggravate the difference between the small and large consumer."

On the contrary, I believe the tendency has been recently, and still is, to discard the system of a certain meter rate with discounts for quantity only, and to adopt instead some form of demand system, which system does not favor the large consumer, but instead gives the low rate to the long-hour consumer, whether he be large or small. The "Readiness-to-Serve" system, which you mention, is a demand system, and has been adopted much more with a view to securing long-hour customers than, as you suggest, with a view to securing merely the large customers.

Both the object and justification of the "Readiness-to-Serve" system, as well as of the other demand systems, is excellently expressed in your own words, as follows:

"It is a system of logically reducing rates to those customers to which the company can afford to give better rates, without letting the bars down to such classes of customers as are unprofitable even at existing rates."

BOSTON, MASS. J. S. CODMAN.

Submarine Boats.—The Compass.

To the Editors of Electrical World and Engineer:

SIRS:—I have lately had occasion to look through the "Mathematical Magick" of Bishop Wilkins, when I came across a chapter with the caption: "Concerning the possibility of framing an ark for submarine navigation: the difficulties and conveniences of such a contrivance."

The difficulties minutely enumerated are three: (*a*) The letting out or taking in of anything without admitting water; (*b*) directing the boat when running submerged, and (*c*) the supply of air needed for respiration.

The conveniences stated are: (*a*) That one may go to foreign ports unmolested and unknown; (*b*) that one is independent of tides and storms as well as secure against icebergs and pirates; (*c*) that one may undermine and blow up ships of the enemy; (*d*) that one may relieve a besieged stronghold by the sea or surprise any place accessible by water, and (*e*) that such a mode of navigation may be of unspeakable benefit for submarine experiments and discovery.

The "mariner's needle," adds the author, would be useful in directing such an ark when running below the surface.

The first edition of this quaint book appeared in 1648. The one from which we quote is in the Wheeler collection of the Library of the American Institute of Electrical Engineers, and is dated 1680.

John Wilkins, Bishop of Chester, was a man of considerable mathematical ability: b. 1614; d. 1672.

In connection with the above, it may be said, following John P. Holland, that the Spanish Armada was probably responsible for the first suggestion of a submarine vessel; also that the first design for such a boat was made by William Bourne in 1604 and that the first submarine vessel constructed and propelled (on the Thames) was by one Cornelius Van Drebble in 1624, just 24 years before the publication of Wilkins's book. Unfortunately, Van Drebble came to be looked upon as a sorcerer, in consequence of which he was compelled to abandon his subaqueous experiments.

MANHATTAN COLLEGE, NEW YORK. B. POTAMIAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motors.—WELSH.—An article giving some points about the induction motor and the effect of variation in the supply circuit. The slip varies approximately as the inverse square of the applied e.m.f. Greater relative changes in speed occur when the voltage is below normal than when it is above normal. This is shown by the following table, which refers to a normal slip of 1 per cent at 100 per cent voltage:

Per cent. voltage applied..	80	90	100	110	120	130	140
Approximate per cent slip	1.5	1.25	1.0	0.8	0.7	0.6	0.5

The torque developed by the motor varies as the square of the applied e.m.f. As a rule the starting torque with the short-circuited type of motor secondary is equal to one and one-half or two times the full-load torque on full voltage, or it is equal to the full-load torque with 82 to 71 per cent of full voltage. The pull-out or maximum torque which the motor can develop on full voltage is commonly two or three times its full-load torque. Roughly the torque is proportional to the inverse square of the frequency; therefore, a decrease in the frequency will increase the maximum torque developed by the motor. The maximum torque of a given motor is a constant, within certain limits irrespective of the slip. If a motor is run at a frequency different than that for which it was designed, the voltage may be changed in the same proportion. The results of an actual test on a 30-hp, two-phase, 400-volt, eight-pole, 60-cycle motor run on 60 and 25.8 cycles are:

Frequency.	Volts.	Amp.	Real Watts.	Torque.	r.p.m.	Slip in r.p.m.	Real efficiency.	Power factor.	Horse power.
60	400	73.5	26400	185	850	50	84.8	89.7	30.0
25.8	170	78.3	12000	185	335	55	73.3	90.3	11.8

The torque was held at 185 pounds in both cases, and the voltage applied in the second case was 25.8/60 of 400 = 170, approximately. In order to develop the same horse-power when a motor is not run

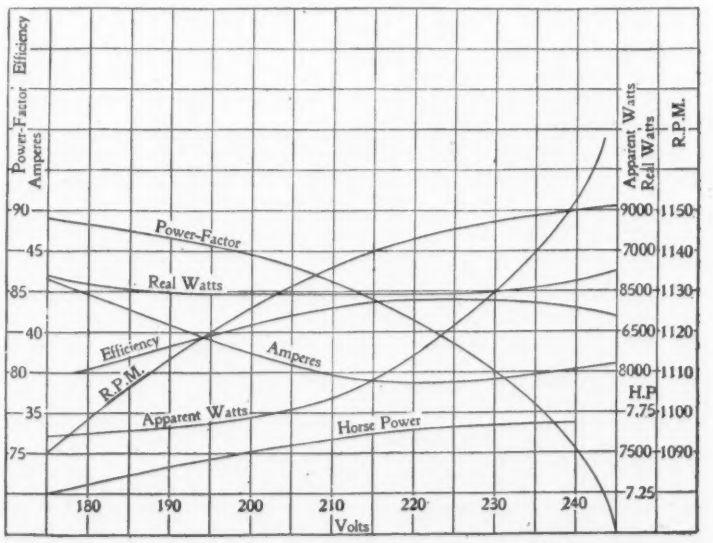
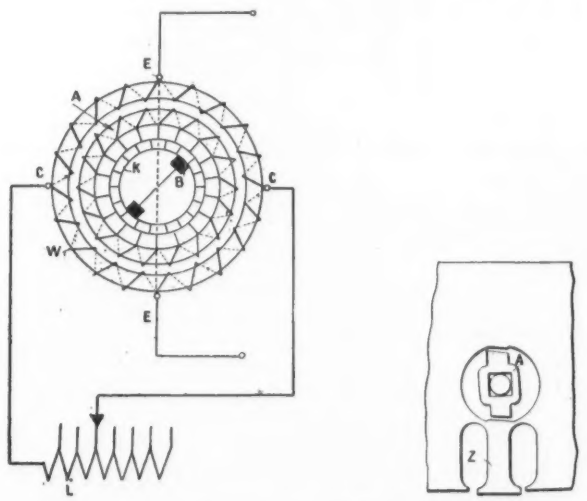


FIG. 1.—PERFORMANCE OF INDUCTION MOTOR AT CONSTANT TORQUE.

at its designed frequency, the voltage should be changed in proportion to the square root of the frequency. For example, a 200-volt, 25-cycle motor may be operated on a 50-cycle circuit with approxi-

mately the same performance if the voltage is increased to 283. In this case the torque has one-half its normal value and the motor runs at double speed. The percent slip is less since but one-half the torque is developed, and the starting torque is less since the voltage is not increased in proportion with the frequency. The performance of a motor at a constant torque at various voltages is illustrated in Fig. 1. The curves were taken by brake test on a motor with a squirrel-cage type of secondary. This motor runs normal at the point on the saturation curve rather high as compared with the usual induction motor. The following peculiarities are mentioned concerning induction motors with a wound secondary. With one leg of the three-phase secondary winding open it pulls in at half speed and continues to run at the same rate. This does not affect the balancing of the current in the primary phases. If the open leg is closed the motor will come up to full speed. Opening one leg again will not cut the speed in two unless the load is too great, in which case the motor will pull out. The pull-out in this case has the same value as with one leg of the primary open, (secondary all closed) about 40 per cent of normal pull-out.—*Elec. Jour.*, September.

Compensated Repulsion Motor.—REYVAL.—An illustrated description of a compensated repulsion motor, built according to the principle of Lehmann by the Société Alsacienne and exhibited at the exposition at Liege. In the ordinary repulsion motor the component of the secondary field, in quadrature with the primary field, produces no useful inductive effect on the primary circuit and acts, therefore, as a self-induction proper. The characteristic feature of Lehmann's compensated repulsion motor is that the transversal flux, in quadrature with the primary field, is partially damped in the stator. This result is obtained by means of the use of an adjustable induction coil, *L*, as shown in Fig. 2., for a bipolar motor. The two



FIGS 2 AND 3.—COMPENSATED REPULSION MOTOR.

points, *C C*, of the primary winding, *W*, are connected to this induction coil, *L*, while the points *E E* are connected to the supply circuit. The winding of the rotor, *A*, is analogous to that of the armature of a direct-current dynamo with respect to the symmetrical distribution of the coils and the commutator, *K*. The latter is provided with two short-circuited brushes, *B*. In such a motor the supply current and the torque vary inversely as the inductance, *L*, and decrease with increasing speed. The phase difference of the supply current decreases constantly with increasing speed, becomes zero at synchronism and changes its sign if the speed is further increased. Another special device, as shown in Fig. 3, permits the suppression of any e.m.f. below the brushes and thus assures perfect commutation. Its feature is that the flux which passes through the teeth of the stator situated in the line of the brushes is influenced by a change of the magnetic reluctance in these teeth. In our special case the reluctance of the teeth, *Z*, is varied by the change of the air-gap between *A* and *Z*. This device has the effect that it suppresses the static tension below the brushes by producing an opposite and equal tension. The tests with this type of motor are stated to have given the following results: At starting one obtains the normal torque without the supply current having more than its normal value. With double the normal current, the starting torque is four times the normal torque. In the neighborhood of synchronism the phase difference of the supply current is practically zero. The reversal of the direction of rotation is obtained by exchanging the terminals, *C C*, with reference to the terminals, *E E*. It is further possible to start with any torque by simply changing the position of the brushes. Finally it is possible to maintain the motor at constant speed either at synchronism or at a multiple of synchronism by short-circuiting the armature and removing the brushes, but in this case the motor is no longer compensated.—*L'Eclairage Elec.*, September 9.

LIGHTS AND LIGHTING.

Efficiency of Incandescent Lamps.—A summary of recent tests made in Paris by Lauriol and Janet for a special purpose of comparing 110-volt and 220-volt incandescent lamps. The results of these tests support the contention that 110-volt lamps are better than 220-volt lamps in point of efficiency (average difference about 20 per cent in favor of 110-volt lamps), useful life and similarity in illuminating power. A great many diagrams are given, one of which is reproduced in Fig. 4, which shows the comparative illumination and

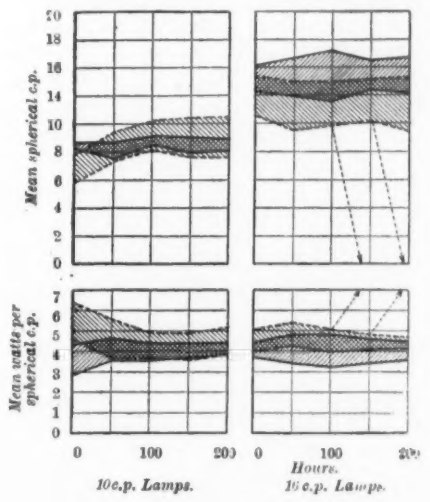


FIG. 4.—EFFICIENCY CURVES.

efficiency tests of one type of French make of 110-volt and 220-volt incandescent lamps. The shaded portions between each two corresponding curves in the diagrams indicate the limits within which the results of the ten lamps tested in each case varied. The full lines refer to 110-volt lamps, the dotted lines to 220-volt lamps. The arrow heads point to the time at which lamps failed. The candle-powers are given in "bougies decimales," being nearly the same as English candle-powers. The curves point to very irregular individual behavior of the lamps. The ratio of mean spherical candle-power to maximum candle-power (in the direction at right angles to the lamp axis) varied from 0.95 to 0.70. In no case did the mean spherical candle-power equal or exceed the candle-power marked on the lamp, and in many cases even the maximum candle-power of the lamp did not equal its supposed candle-power. Tests by Janet gave the average results shown in the following table:

	5 c.p.		10 c.p.		16 c.p.	
	Max. illum. c.p.	Watts per c.p.	Max. illum. c.p.	Watts per c.p.	Max. illum. c.p.	Watts per c.p.
110 volts.	6.34 (0.71)	3.52	10.5 (0.73)	3.58	16.2 (0.81)	3.66
220 volts.	7.43 (0.69)	3.82	9.2 (0.71)	4.54	14.0 (0.75)	4.57

The figures in brackets in this table are the ratios of the main mean spherical candle-power to the maximum candle-power. It is mentioned that this ratio is largest in the lamps with four spirals and smallest in lamps having two horseshoe filaments. If the aggregate hours of burning of a group of five lamps of one type be divided by 1,000, a figure is obtained which Janet calls the "durability coefficient," and which is to some extent an indication of the durability of the lamp. The 220-volt lamps deteriorated more rapidly on the whole than the 110-volt lamps. After 200 hours the average consumption of the 220-volt lamps tested was 34 per cent higher than that of the 110-volt lamps. Janet finally points out that the use of 220-volt lamps is only now becoming common in France and that it would be unfair to form final conclusions as regards 110-volt lamps versus 220-volt lamps from the figures quoted. Bainville has made some tests to determine the approximate degree of blackening which may take place in incandescent carbon lamps. He took some

old lamps, measured their illuminating power, cleared the lamps inside, replaced the filaments, exhausted the lamps and measured their candle-power again. The results obtained with three lamps are given in the following table:

		Cleaning		
		Before.	After.	
250 volts.	0.24 amp.	7.7 c.p.	10.77 c.p.	20.6 per cent.
120 vols.	1.33 amp.	13.1 c.p.	44.0 c.p.	70.0 per cent.
125 volts.	0.78 amp.	22.7 c.p.	47.86 c.p.	54.0 per cent.

The accuracy of these figures cannot be very high, since the vacuum presumably differed in the two cases. The influence of a variation of voltage on the specific consumption of normal 110-volt lamps is shown in the following table:

Specific consumption.	Watts per c.p.			
Normal consumption	3.5	3.0	2.5	2.0
Consumption for voltage 5% below 110	5.9	3.5	3.1	2.7
Consumption for voltage 5% above 110	2.7	2.4	2.0	1.65

Bainville also compared the effect of small and large globes for 106-volt, 100-cp lamps. He found that lamps with large globes are much more constant in illuminating power and efficiency than lamps with small globes.—Lond. *Elec.*, September 1.

Osmium Lamp.—An account illustrated by diagrams of tests of osmium lamps recently made in Vienna. The lamps tested were six 35-volt lamps giving 16 cp and six 35-volt lamps giving 25 cp. One 16-cp lamp gave initially 15.1 candles, with a consumption of 1.68 watts per candle; after 400 hours the candle-power increased to 17.3; at 2100 hours it had decreased to 15.6, the consumption of watts per candle-power at the same moments being 1.46 and 1.58, respectively. One 25-cp lamp began with 22.35 candles, was at 600 hours at 24.6 cp and at 1700 hours at 23.7, the consumption in watts per candle-power being 1.65, 1.51 and 1.56, respectively. The mean total life of the 12 lamps tested was 2,220 hours, the limits being 1,793 and 3,036 hours, respectively. Of the 12 lamps only three lost 10 per cent of their initial candle-power during their total life; one after 1,750 hours, the second after 940 hours and the third after 820 hours. If the "useful life" is considered as the life down to 90 per cent of the initial candle-power, the mean useful life of the 12 lamps was 1,985 hours with a mean consumption of 1.60 watts per candle-power for the 16-cp lamps and of 1.80 watt per candle-power for the 25-cp lamps. (In this article candle-power evidently means Hefner candle, which is equal to 0.88 cp in this country).—*Zeit. f. Elek.* (Vienna), September 3.

Carbon Arc.—Becknell.—Experimental researches as to the phenomena in the intensely heated region between the electrodes of a carbon arc immediately after its interruption. A current which may be called residual current can be observed for more than 10 seconds after the interruption of the arc. The residual e.m.f. is counter to that of the dynamo and reaches a maximum value of more than one-half a volt. It seems not to be a case of ordinary electric conduction but probably one of electric convection. Ohm's law does not hold for the residual current. A possible explanation of the phenomena is given on the basis of the ionic hypothesis.—*Phys. Rev.*, September.

Energy of Visible Spectrum.—Nichols.—An account of experimental investigations with a summary of results obtained by other authors on the distribution of the energy in the visible spectrum of various sources of light.—*Phys. Rev.*, September.

Power.

Transmission Troubles.—Appler.—Some illustrated notes on transmission troubles in the far West. The greater number of the troubles encountered are due to climatic and physical conditions of the country rather than of the apparatus. Several cases are mentioned in which troubles were experienced at times of unusual high water in hydraulic stations. At the power house at Volta, Cal., the exciter unit has a separate pipe line, and it was found necessary to provide some device that would automatically remove the leaves which are in the water in times of heavy rains before entering the penstock. In another plant at Kilarc water is taken from the main pipe line, driving the exciter with the same water pressure as used on the big wheels, and this has proven a more reliable method.—*Elec. Jour.*, September.

Electric Power in German Coal Mines.—Brown.—An abstract of a paper read before the Mining Institute of Scotland. In nearly all German mines three-phase currents are used with rare exceptions for general power purposes. "At coking colleries there is a tendency to take gas from the coking ovens, which after purification is used to drive gas engines; and it is stated that the power generated by this method, as compared with that of burning the gas under boilers and generating electricity by the steam so raised, is rather more than double." Electric power is used for pumping and ventilation, winding, haulage, coal cutting and air compressing. Some information is given on electric winding engines.—Lond. *Elec. Rev.*, August 25.

Boiler-Feeding Apparatus.—Hubbard.—A short illustrated article describing the operation of the injector for boiler-feeding purposes.—*Am. Elec.*, September.

Open Feed-Water Heaters.—Edwards.—An illustrated article pointing out the advantages possessed by the open type of feed-water heater, and describing its various applications.—*Am. Elec.*, Septembee.

Piston Rod Packing.—Strohm.—An illustrated article describing the various forms of packing used for piston rods.—*Am. Elec.*, September.

Traction.

Corrugation of Tramway Rails.—An illustrated note on the trouble of the corrugation of tramway rails. Fig. 5 shows a photograph

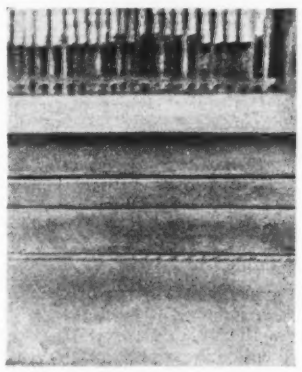


Fig. 5.—Corrugations.

from a suburban line where the corrugation is pronounced and causes a serious amount of noise. In an editorial note attention is called to the lateral spreading of the rail table at the high parts until met by the wheel flanges. The consequent burnishing furnishes the quickest method of picking out corrugated rails by sight, with a good side light. This trouble never seems to have occurred upon either steam or horse tramways, but on cable tramways it has been known for some time. It has been claimed that vertical springing of the rails starts the corrugations, and that it can be prevented and cured by "anchor plates," but the writer says that this explanation does not fit, since some of the systems which are free from the trouble use no anchor plates, even at the rail joints, while cable and conduit lines, both of which have suffered, have a certain amount of anchoring from the yokes. Some relation between wheel gauge and rail gauge seems a more likely cause, and the lateral spread noticed lends force to this suggestion.—Lond. *Elec.*, September 1.

Electric Transportation of Mail and Express Packages.—A fully illustrated article on trials, recently made in Paris on high-speed transportation of letters and packages. A speed of 250 km. or 155 miles per hour is contemplated. The difficulties of construction at curves are discussed. Four-pole, three-phase induction motors are used with a voltage of 1,000 and a frequency of 40. The vehicle is adapted to carry a weight of 500 kg. (about 1,100 pounds); its length is 25 ft., its width 3½ ft. and its height above the rails 4⅓ ft. The space for the freight is about 70 cu. ft.—*L'Industrie Elec.*, August 25.

British Tramway.—An illustrated description of the new tramway system of Erith with a track of 8.4 miles. Erith already has a municipal electric light and power supply which was the first public three-phase plant in the United Kingdom. To supply current for tramways, two rotary converters of 150 kw each and a 75-kw negative booster have been installed.—Lond. *Elec. Rev.*, September 1.

Couplings.—Mykisch.—An illustrated description of various types of couplings of electric cables between motor cars for trunk railroads.—*Elek. Bahnen*, August 14; from *Glaser's Ann.*, No. 670.

Installations, Systems and Appliances.

Starting Rotary Converters.—Wagner.—The conclusion of his serial, illustrated by detailed diagrams, on different cases of starting

rotary converters. The case discussed in the present installment refers to the starting of a three-phase rotary converter operating from direct current to alternating current with direct-connected exciter.—*Elec. Jour.*, September.

ELECTROPHYSICS AND MAGNETISM.

An Experiment in Electricity.—WORTHINGTON.—A description of "a fundamental experiment in electricity." The object was to ascertain whether any difference can be detected between space at a high electrical potential and space at a low potential, quite irrespective of the existence of any electric field in the space in question." He examines whether any difference could be detected in the velocities of light passing through two tubes, the interior of one of which was at a high, and of the other at a low potential. The result was negative. The difference of potentials was 60,000 volts. In a length of 152 cm. of air this does not produce a measurable effect under the conditions of experiment. If there is any difference in the velocities it is less than 1/53 of one-millionth of the whole.—*Phil. Mag.*, September.

Production of Radium from Uranium.—BOLTWOOD.—The hypothesis that radium is a disintegration product of uranium has been greatly strengthened through the demonstration of the fact that in radioactive minerals the quantity of radium is directly proportional to the quantity of uranium present. Soddy has recently claimed to have shown by direct experiment that radium is produced directly from uranium by atomic disintegration. The present author has made an analogous investigation using the very greatest precautions. His results are negative. He states positively that in 390 days the quantity of radium formed from 48 grams of uranium in a uranium nitrate solution must be less than 1.7×10^{-11} gram. This would be less than 1/10th of the quantity assumed by Soddy to have been formed from an equal quantity of uranium of his solution during an interval of 18 months. It is, therefore, concluded that Soddy's results are without significance and that one or more products of a slow rate intervene between uranium and radium.—*Am. Jour. of Science,* September.

Radium.—RUTHERFORD.—A full account of an extended experimental analysis of slow transformation products of radium.—*Phil. Mag.*, September.

Electromagnetic Screening Effect of Metallic Conductors.—KUNITO OGAWA.—A note giving in tables and diagrams the results of experiments concerning the screening action of simple metallic loops and thin metallic foils.—*Memoirs College Sc. & Eng.*, Kyoto Univ., Vol. I, No. 2.

ELECTROCHEMISTRY AND BATTERIES.

The Space Occupied by Atoms.—TRAUBE.—A summary of the investigations of T. W. Richards and J. Traube on the space occupied by atoms. Traube distinguishes three volumes—internal, external and "co-volume"—the latter being the space within which the atoms are free to move. The space occupied by an atom changes from one compound to another; it is the smaller the greater the affinity of the atom in question for the neighboring atoms with which it is combined. There is an intimate connection between the molecular volume and the thermochemical constants, especially the heat of formation. A far-reaching parallelism exists between heat of formation and atomic contraction and the heat of reaction is, as a first approximation, equivalent to the work represented by the contraction of the atoms. When we consider that the electrical energy which a galvanic cell is capable of generating may, as a first approximation, be equated to the heat which under ordinary circumstances the reactions taking place in the cell are capable of developing, it necessarily follows from the relation of this heat development to the dynamical contraction energy, that the electric energy of a cell is to be attributed to the mechanical work accompanying atomic contraction. The various properties of matter are related to the atomic volumes much more simply and directly than to the atomic weights. The numerical relations among the atomic spaces are likewise simpler than those among the atomic weights. The properties of the elements and their compounds are primarily functions of the atomic and molecular volumes and possible shapes. The author discusses the points of agreement as well as of disagreement between the views of Richards and Traube.—*Phil. Mag.*, September.

Absolute Potentials.—GOODWIN AND SOSMAN.—An account of an experimental investigation of Billitzer's method for determining absolute potential differences. This method is based on the observation of deflections of a minute metallic electrode, suspended in various solutions, under the influence of an electric current. The results obtained by the present authors have failed completely to confirm the measurements obtained by Billitzer, and they are forced to the conclusion that the method proposed is not to be relied upon for the purpose for which it was developed. This is further strengthened by the results on the migration of colloids obtained by Blake, who has also failed to confirm Billitzer's measurements using the colloid method. So far as the experiments go, it would seem that most of the phenomena observed may be explained on the assumption of the negative migration of gaseous particles in the liquid, as first demonstrated by Quincke in 1861. The authors believe, therefore, that the results obtained by Billitzer by the above described method afford as yet no sufficient grounds for rejecting the generally adopted values for the potential of the normal (or tenth normal) calomel electrode.—*Phys. Rev.*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Reichsanstalt.—An abstract of the recent report of the German Reichsanstalt for 1904. This is the last report signed by F. Kohlrausch as president, who has resigned during this year and is succeeded by Warburg. The report covers work on specific heat of gases and of water vapor; the determination of the mean value of a calorie in electrical units (the resulting mean calorie being 4.19 watt-seconds at 15° C., and its temperature coefficient being —0.0038 per degree C. for the range from 5° to 25° C., which agrees with Barnes); physical properties of metals (with respect to the electron theory); the expansion coefficients of metals at low temperatures; the internal friction of liquids; the setting of masonry foundations for astronomical instruments; standard cells (the troubles caused by mercurous sulphate do not all appear to have been overcome); conductivity of salt solutions; temperature radiation (the energy curves of the black body radiation agree entirely with Planck's theory). An account is then given of the apparatus and instruments which were tested. The investigation into the constancy of electricity meters for central stations is nearly completed. A number of instruments have been carefully tested, then distributed over various works and have been retested at intervals. These tests of 154 instruments have extended over two or three years. Results will be communicated to the respective firms, but will not be published in detail. The work is said to have been most instructive for both sides. Alternating-current instruments have, on the whole, proven superior to direct-current instruments. The e.m.f. of the Weston cadmium cell was found to be 1.0189 in 5 cells, 1.0190 in 5 cells, 1.0191 in 26 cells and 1.0192 in 4 cells. The Reichsanstalt declares its preference for the Weston cell over the Clark cell, but it regrets that water can evaporate in these cells as furnished by the Weston company, although the modification devised by the Reichsanstalt is free from this effect. Considerable work has been done on the testing of the magnetic properties of iron as has already been noticed in the Digest. An important result is that for permeability tests the direct-current method gives the same results as the less convenient and reliable method of testing with the aid of alternating currents. Iron is not magnetically less soft to rapid current alternations than to direct current, and the permeability does not become smaller at higher frequencies. There is a slight difference in the sense indicated for periods up to 50, and for inductions below 12,000. The watt-metrical method seems, on the whole, to be most suitable for the determination of hysteresis losses. One point requires further elucidation, however. The initial permeability values, i. e., the permeability in very weak fields, as determined by different methods (commutation curves and ballistic yoke methods) were not found identical.—Lond. *Eng'ing*, September 8.

Measuring Mean Spherical and Mean Hemispherical Intensities.—HYDE.—A discussion of the theory of the Matthews and Russell-Leonard photometers for the measurement of mean spherical and mean hemispherical intensities, and their applications both to arc lamps and incandescent lamps. The paper is chiefly mathematical and relates to the number and location of the mirrors employed.—*Bull. Bureau of Standards,* No. 2.

Absolute Measurement of Inductance and Capacity.—ROSA AND GROVER.—Two very long and detailed accounts of experimental invectigations on methods of absolute measurement of inductance and capacity.—*Bull. Bureau of Standards,* No. 2.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Central Battery System.—JACOBS.—A long and fully-illustrated description of the central battery system in the telephone exchange of Wuerzburg, Bavaria.—*Elek. Zeit.*, August 31.

BOOK REVIEWS.

RADIOACTIVE SUBSTANCES. By Madame Sklodowska-Curie. Reprinted from the *Chemical News*. New York: D. Van Nostrand Company. 94 pages. Price, $1.

This work of the distinguished Polish lady was prepared and submitted by her for the degree of Doctor of Science of the University of Paris. It embodies the extensive researches into the new phenomena of radioactivity which were discovered by herself within the past few years.

It was by the study of phosphorescence due to uranium, a discovery of Henri Becquerel, that Madame Curie was led to recognize an order of phenomena hitherto unknown to science, the very subtlety and complexity of which served only to stimulate her interest and to intensify her powers of patient analysis. Facts accumulated by degrees, and it was only when assurance had become doubly assured that the announcement was made to the world of the discovery of a new elementary form of matter. Its peculiar behavior, and above all, its irrepressible emissivity, secured for it the apt name of radium. The various and laborious steps leading up to its detection, its activity, its emanations and astounding properties are successively described in the present classical thesis, which, while revealing a new world of physical wonders, has given a powerful impetus to research, rare material to the framers of theories and much concern to the sober thinker and sedate philosopher. Our views of matter are undergoing a rapid process not of evolution but of revolution; the element of the chemist is no longer that of the physicist; the one-time indivisible entity is now mercilessly shattered into fragments in order to satisfy the requirements of (peace to the shades of Dalton!) and the stability of the atom as well as the permanence of the various forms of matter are beginning to disappear from the articles of our scientific creed.

Of course, the Curies are not the only pioneers in the new physics of our planet. Becquerel must not be forgotten no more than Crookes, W. Konrad, Röntgen or Philipp Lenard. Their splendid work prepared the way, it is true, but it required that infinite ability of looking after minutiæ, frequently called genius, to pass from the domain of such recondite researches into the promised land of radioactivity. The merit of Madame Sklodowska-Curie has been rewarded by the Doctorate of the French University and also by the admiration of the whole scientific world.

RADIOACTIVITY. By Charles R. Stevens. New York: Broadway Publishing Company. 108 pages.

The title of this book does not indicate the purport or the scope of the work. One would naturally think of it as a comprehensive treatise on the engrossing and fascinating subject of the hour, whereas radioactivity is not seriously considered until the tenth and last chapter. The other nine deal with such a variety of subjects as the Permanence of Force, the Permanence of Matter, the Infinity of Matter, Motion, Form, Immutability of the Natural Law, Energy and the Ether. These captions will at once suggest that the book was not written for the student in the class room, but rather for the philosopher in his study. And indeed the treatment is anything but elementary and didactic. It is not the tyro that can read these pages intelligently; indeed their perusal by one not well up in physics and metaphysics would be attended by serious intellectual risks and dangers. The author is affirmative and dogmatic, never discussive nor argumentative. He states his views upon all points with absolute confidence as to their finality. It is just as he puts it and could not be otherwise. The philosophy of the book may be judged from the following: "Ether is matter and is subject to all the laws which govern matter" (p. 9); "force and matter have always existed" (p. 15); "An elemental atom is an immortal being uncreatable and indestructible" (p. 17); "ether is a material substance just as much so as iron" (p. 61); "the lines of force surrounding a magnet are ethereal waves that move in the path of least resistance from pole to pole" (p. 62); "since ether is matter, therefore it is ponderable" (p. 9); "gravity is motion of matter" (p. 52); "the infinity of space is axiomatic" (p. 19). Again: "The supposition of a first cause is idle and preposterous" (p. 15); "the conception that the universe has always existed is a basis on which theories may safely and reasonably be built" (p. 15); "the mind of man is not simple, neither is it immaterial" (p. 81); "that which cannot be destroyed cannot have been created" (p. 15).

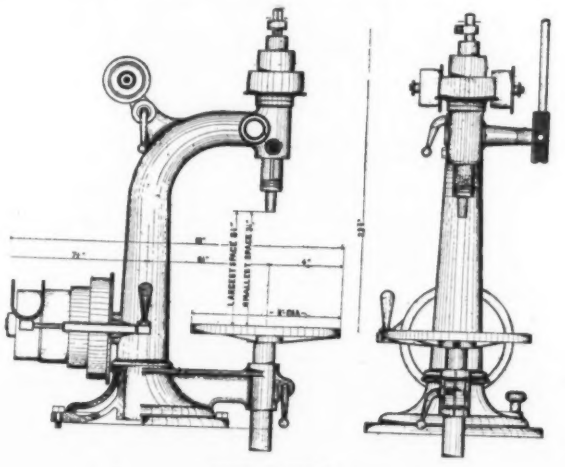
The facts contained in this discussive little book are many; they must be accepted; but the views of the author, especially his philosophical views, are debatable and unsafe.

BOOK RECEIVED.

WIRELESS TELEGRAPHY. Its History, Theory and Practice. By A Frederick Collins. New York: McGraw Publishing Company. 299 pages, 332 ills. Price, $3.00.

Sensitive Bench Drill.

The accompanying illustrations show a new 10-in. sensitive bench drill which is particularly adapted for various electrical manufacturing purposes. The principal features of the new drill are a revolving base and table, crucible steel spindles and bronze sleeve for the spindle shaft. Particular attention has been paid to the matter of interchangeability of parts, every part being made to jigs and



BENCH DRILL.

accurate gauges so that no trouble will be encountered in replacing worn-out or broken parts. In the design of the machine careful attention has been paid to proportioning the metal, which is so distributed as to make the machine uniformly stiff to withstand drilling strains. It will be noted that the limit of drilling height is unusually large for a machine of this type. The matter of finish has also received careful thought to the end that a customer will not only have a well-proportioned, well-made and well-fitted machine, but one good looking in every respect. This drill is made by the McGeorge Manufacturing Company, Cleveland, Ohio.

Electrical Equipment of the B. F. Sturtevant Company Works.

BY HOWARD F. KNOWLTON.

One of the most recent industrial plants to be completed in the suburbs of Boston, Mass., is the large establishment of the B. F. Sturtevant Company, formerly of Jamaica Plain, Mass. The growth of the old plant as far back as 1901 demonstrated the need of a new location, and a fire in that year which destroyed a large amount of valuable machinery naturally hastened the development of a new factory. This is now located about three-eighths of a mile north of the Readville station in the town of Hyde Park, and the plant comprises a group of buildings thoroughly representative of the latest ideas in production economy. The company manufactures heating and ventilating apparatus, engines, dynamos and motors, economizers, forges, exhaust heads, general factory equipment, etc.

The site consists of about 20 acres of land, with a frontage of 1,300 feet along the N. Y., N. H. & H. freight yards near Readville, occupied by about a dozen buildings with an aggregate floor area of 9 acres. These are mainly as follows:

Building.	Length, inches.	Width, inches.	No. stories	Class of Work.
A	125	45	4	Office.
B	250	80	3	Testing and electrical mfg.
C	500	80	3	Fan and heater shop.
D	500	120	3	General machine shop.
E	150	80	2—4	Patterns and storage.
F	350	170	1	Foundry.
G	100	40	2	Lockers and work rooms.
H	100	40	2	Blacksmith shop.
I	80	80	2	Power house.
J	25	20	1	Pump house.

of 2 in. in the pattern building with 2½ in. in the office building, and a 14-in. pipe carrying 5 lb. pressure to the various heating coils. The high-pressure steam is reduced to 80 lb. for the operation of fan engines, and the latter exhaust into the heating system, which is a typical Sturtevant installation. The testing department uses 160 lb. steam in its work upon compound, direct-connected sets.

All the electrical distribution is carried out upon the two-wire plan

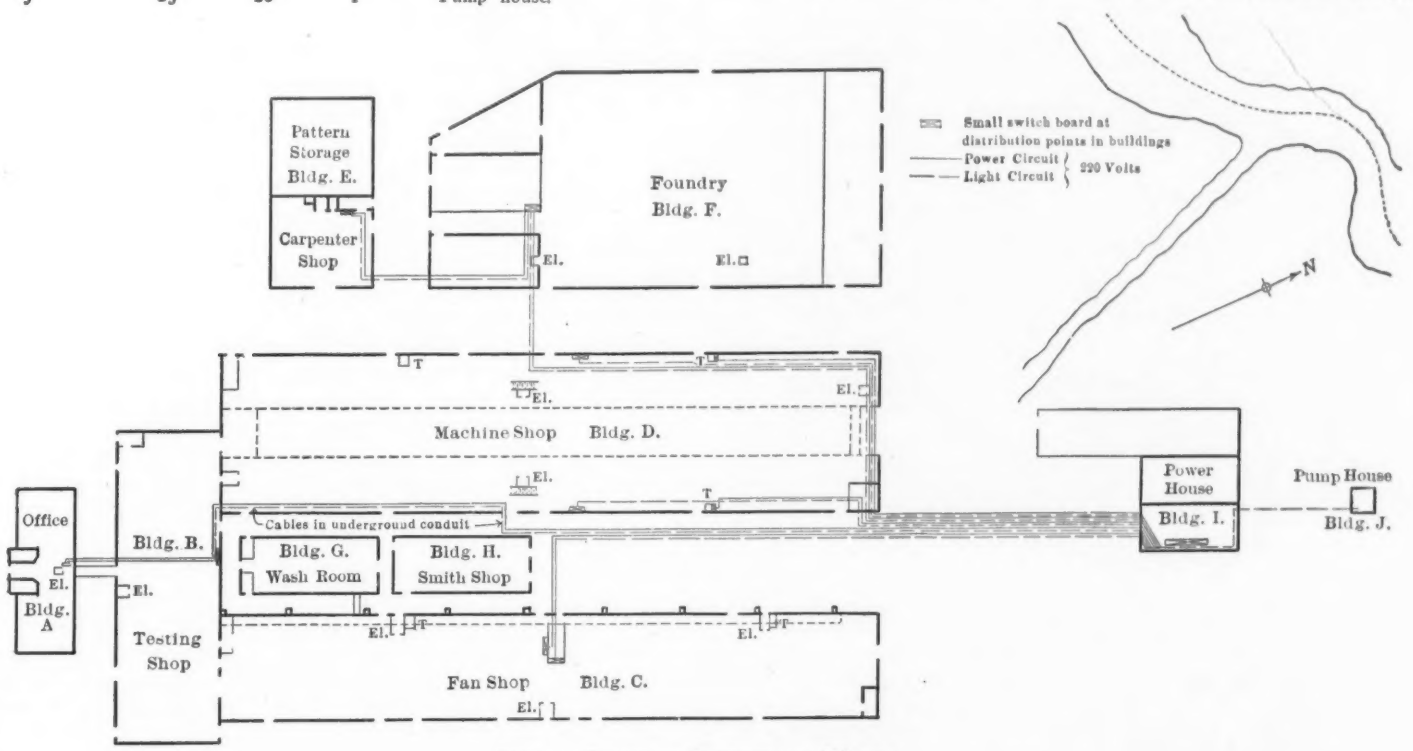


FIG. 1.—PLANT OF STURTEVANT WORKS.

The arrangement of the buildings is such as to limit as far as possible internal transportation to straight line movements. A complete industrial railway system of 2 ft. gauge connects all departments; spur tracks from the New Haven yards facilitate the movement of raw material and products; traveling cranes, pneumatic, electric and manual hoists and electric elevators are scattered throughout the works and all machinery is motor driven with the exception of the ventilating fans and air-compressor equipment. The building construction is of composite character, consisting of steel interior columns and main steel girders, with brick walls, timbered floors and plank roofs. Ribbed glass is used in all windows except in the lower sashes, and the natural lighting is remarkably effective, especially in the machine shop, which is supplied through a series of crosswise saw-tooth skylights with the glass facing due north. Fire protection conforms to the New England Factory Mutual standards or their equivalent. About 3,800 Grinnell automatic sprinklers are in service; fire hose is stored in red-painted boxes for emergency use; self-closing fireproof doors are installed between many of the departments; fire pails are frequent in conspicuous places, and a night watchman service is maintained. Water at 90 lb. per sq. in. is available from the Hyde Park system, and a 1,000 gal. per min. Blake Underwriter's Fire pump is installed in a house near the power plant.

The power plant was located about 250 ft. north of the shop buildings, so that the latter might be amply extended, with the former still near enough to reduce to a minimum the expense of conveying condensing and other water, transmitting steam, electricity and compressed air. The boilers are of Stirling make, with a total rating of about 1,000 hp, and the plant naturally contains mechanical draft apparatus and a Sturtevant economizer. The generating sets were built by the company and are at present two in number, 100 kw and 250 kw. The engines are of the vertical, cross-compound type and are operated condensing. A concrete tunnel 6 ft. 6 in. high and 5 ft. wide connects the power house with the various shops, and it contains all piping and transmission circuits. It is lighted by incandescent lamps controlled from the power house end—a point of considerable convenience when inspection and repairs are desired. The power house supplies all the steam used in the different buildings through an 8-in. 160-lb. line which branches to a minimum diameter at 220 volts direct current for both power and lighting. The largest cable used in the ducts is 1,500,000 c.m. A maximum drop of 2½ per cent was figured between the power house and the load. General illumination is supplied by General Electric 110-volt enclosed arc lamps run two in series, and all special lighting is by 16-cp, 220-volt incandescents. The air compressor in the power house is a Laidlaw-Dunn-Gordon machine with compound steam and compound air

FIG. 2.—SWITCHBOARD AND MOTORS IN TESTING DEPARTMENT.

cylinders, distributing air at 100 lb. pressure throughout all the shops. Junctions in the main 6-in. supply pipe provide for the different buildings, which are supplied by 3-in. pipes. Tools are supplied through 1-in. pipes and the air is widely used in drills, hoists, riveting hammers, chisels, snaggers, for blowing out generators, motors and cylinders.

There are about 100 electric motors in the plant, varying in size from ¼ to 40 hp, all being of the company's own make. Both group

and individual driving of machines are in use. The tools are in general arranged to facilitate the direct progress of the work from the receiving ends of the shops toward the finished stores, erecting, testing and shipping departments. Machines, group driven, are as a rule operated in sets requiring about 20 hp, and a motor of this capacity is assigned to all such groups. The machines are as far as possible arranged in duplicate and space is left for additions in sup-

FIG. 3.—GROUP DRIVE IN MACHINE SHOP GALLERY.

plementary parallel rows. All motors above 10 hp are equipped with General Electric circuit-breakers, enclosed fuses being used in smaller sizes. Starting boxes and controlling switches are located either on posts close by the machines, or in the case of some connected motors, upon the machine frames. Practically all the motors used in group driving are hung from the ceilings. The starting boxes are equipped with self-closing doors lined with asbestos. The bench lighting is arranged so as to give each employee as far as possible left shoulder illumination. Incandescent lamps for this work are hung from porcelain rosettes attached to a horizontal wooden strip suspended upon wall brackets. The strip is about 10 ft. above the floor and the lamps, with attached downward reflectors, are about 1 ft. above the average man's head. At various points in the factory where power is required for testing or other temporary purposes, plug boxes are installed upon certain of the vertical columns within easy reach of the floor. These boxes are fitted with one jack on each side and with fuses or other circuit-breaking devices inside, self closing doors and asbestos lining.

FIG. 4.—1-TON ELECTRIC HOIST.

Several motors are effectively used in the pattern shop and foundry. In the former, the flask shop band, cross-cut and splitting saws, boring drill machine and lathe are all driven by a 10-hp motor, while the carpenter shop or pattern-making division proper is equipped with two 10-hp motors which operate two band saws, a buzz planer and a double surfacer, five lathes, a drill press, core box machine and wood trimmers. Both these motors are required in ordinary work, one serving as a possible relay in case of accident. In the foundry, a 15 and two 20-ton Whiting electric traveling cranes are in regular use upon the two runways, and the floor between the runways is served by a number of 1½-ton electric traveling hoists with 10 ft. span, built especially for the work by the company. The cupolas are two in number, of Whiting make, 56 in. and 72 in. in diameter. The former is supplied with air by No. 8 Sturtevant pressure blower driven by a 30-hp motor, and the latter by a No. 10 blower driven by a 40-hp motor. In the brass foundry, blast for the furnaces is supplied by a No. 3 Monogram blower, and the entire machinery, consisting of a sprue cutter, a magnetic separator, a tumbling barrel and emery wheels, is driven by a 5-hp motor attached to the wall. A 5-ton three-motor electric Whiting crane serves the principal portion of the floor in the cleaning room. In the core department is a Blake wire straightener, driven by a 5-hp motor.

The more important direct-connected tools are located in the machine shop and fan and heater building, first floors. In the former, the principal machines direct-driven are:

1 Dietrick and Harvey 60-in., open side, 16-ft. planer, belted to 15-h.p. motor.
1 Dietrick and Harvey 72-in., open side, 18-ft. planer, belted to 20-h.p. motor.
1 Baush vertical boring mill, 6-ft. swing, back geared, belted to 1½-h.p. motor.
1 Baush vertical boring mill, 8-ft. swing, plain, belted to 10-h.p. motor.
1 Beaman and Smith horizontal boring mill, 5-ft. swing, geared to 2-h.p. motor.
1 Johnson lathe, 48-in. swing, geared to 7½-h.p. motor, speed variable.
1 Cincinnati planer, 60-in. x 48-in. x 16-ft., four heads, geared to 20-h.p. motor.
1 Landis grinder, driven by a 15-h.p. belted motor, with mechanical rheostat and control from working centre.
1 Bullard 76-in. boring mill, belted to 5-h.p. motor.
1 Chucking lathe, 3-h.p. geared motor.
1 Niles 60-in. boring mill, 2 heads, belted to 7½-h.p. motor.
1 Niagara circular shear, geared to 10-h.p. motor.
1 Bliss gate shear, geared to 15-h.p. motor.
1 set Hilles and Jones bending rolls, geared to 15-h.p. motor.

The latter machines and rolls will cut and fold plates up to 120 in. in length and width, and from ¼ in. to ½ in. in thickness.

All the elevators in the works are electrically driven by Sturtevant motors. Those in the shops and testing building are:

No. Maker.	Lftg. cap, tons.	Travel, feet.	Speed feet p. min.	Platform.	Motor. h.p.	Drive.
Fan Shop 2, Salem	3	32	50	7′3″x12′3″	10	belt.
Fan Shop 1, Morse	5	32	50	9′6″x12′8″	20	flex. coupl'g.
Mch. Shop 1, Morse	3	32	50	9′0″x12′8″	15	chain.
Mch. Shop 3, Morse	2	17	50	9′0″x10′4″	10	chain.
Test Bldg. 1, Morse	2	32	50	8′6″x8′4″	10	chain.

The principal travelling cranes are all of Whiting make, with Sturtevant motors. The machine shop is served by a 10-ton crane, span 37 ft. 7¾ in., lift 23 ft. 0 in., speed, motor hoist, 15 ft. per min., bridge travel, 350 ft. per min., trolley travel 120 ft. per min., motors, trolley travel 15-hp., hoist 15-hp, bridge travel 2½-hp. This crane serves the entire floor, handling large castings and forgings at one end, and at the other end depositing the substantially completed engine or generator upon a transfer car which passes through to the testing building, where a 15-ton crane picks up the machine, drops it upon the testing plate and subsequently carries it forward to the shipping department. The crane on this floor has a 36-ft. 7⅞-in. span, a 21-ft. 3-in. lift, main hoisting speed, 10 ft. per min., bridge travel 275 ft. per min., trolley travel 120 ft. per min., two 15-hp motors on the hoist and trolley travel, and a 2½-hp on the bridge. The fan shop is served by a 5-ton crane, which travels half its length, the floor height throughout the area being 32 ft., to provide for the construction of very large steel plate fans. This crane has a 36-ft. 11⅛-in. span, lift 23 ft. 4 in., speed 15 ft. per min., on main hoist, 7½-hp motor, 250 ft. per min. bridge travel, 2½-hp motor, trolley travel, 120 ft. per min., 7½-hp motor. An interesting feature of the fan shop is the storage of nearly 1,000 tons of plate iron on edge in diagonal alcoves just outside the

FIG. 5.—GENERAL VIEW OF WINDING DEPARTMENT.

building. By means of a small two-wheeled truck, built especially for this work, one man can easily handle plates of sheet iron 120 in. x 64 in. x ¼ in., weighing some 320 lbs., when formerly the plates had to be dragged about the shop by sheer force of muscle.

Armature punchings and commutators are built up in the uppermost floor of the fan and heater shop, adjoining the testing building. The storage of commutators and parts is effected on divided pigeon

holes, numbered according to the shop scheme for quick reference. The armature baking room is 40 ft. square, entirely fireproof, and it contains two steam heated baking ovens, fitted with sheet iron doors and discharge ducts. At the other end of the building is the special store room for electrical supplies. The balance of this floor and of the intermediate floor below is devoted to winding, assembling and testing. The electrical designs are worked out in the office building, and a remarkably complete card catalogue system of filing machine data is in service in that department. Cross references are liberally included so that any machine sent out can be at once identified, no matter how meagre may be the information returned by the correspondent. The essential data of the machines are filed in this manner, but the final detailed particulars are kept in a fireproof vault.

Heavy testing is mostly carried out upon the first floor. Here is a testing plate 30 ft. x 60 ft., completely equipped with steam and electrical connections; engines may be run condensing or non-condensing, and efficiency tests, compounding tests and heat runs conducted. Flexible and rigid pipe sections, portable belted tachometers, steam trap and electrical testing connections, movable racks of lamp banks, scales and water rheostats complete the equipment.

The winding department on the third floor is arranged conveniently with bench scales, reel frames, magnet connections at intervals of 20 ft., lamp banks and armature racks. The latter are group-driven, and the daylight supply is admirable. The testing magnet is mounted on a bracket attached to an upright column and is permanently driven by belting from an overhead line shaft. The special trucks used in handling armatures also deserve mention. Small travelling cranes and hoists are constantly in use on this floor, which is equipped with a floor plate for testing motors and blowers. A complete permanent switchboard forms part of the testing room equipment and all direct-current voltages from 80 to 550 are available for testing, as well as alternating voltages up to

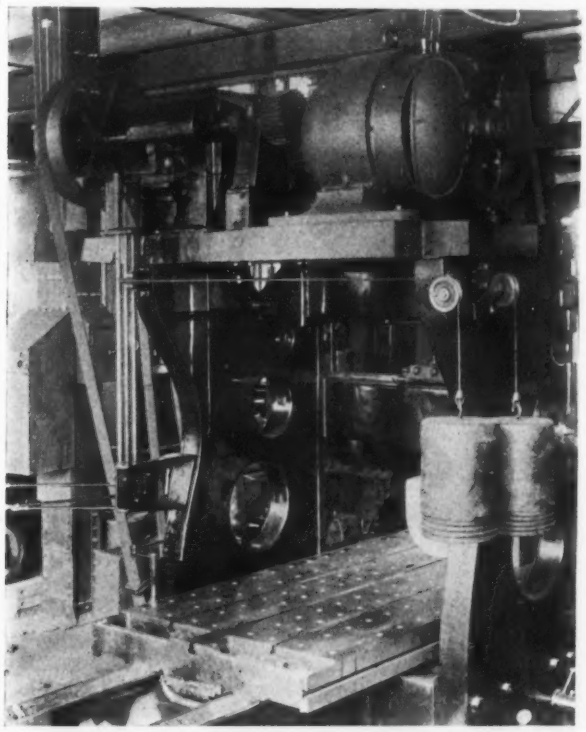


FIG. 6.—LARGE MOTOR-DRIVEN PLANER IN MACHINE SHOP.

2,500, the latter being used in insulation breakdown tests. On the rear of this board are circular bus-bars, to which flexible cables may be clamped as may be convenient. The variation in voltages is obtained by operating the motor generator sets shown at the left of the switchboard in the illustration. Portable test tables and lamp banks are available; a water rheostat plant is located on the roof, and instruments are stored in the office, which is being equipped for B-H curve tests upon samples of iron used in the machines. The foundry of the company supplies this material, which runs evenly most of the time, but which needs checking magnetically now and then.

The tests performed upon the equipment vary according to the specifications of the purchaser, but all the generating sets and motors are built to withstand the severe requirements of the U. S. Navy. All apparatus sold to the government is subjected to the exhaustive tests which the departments specify; but even commercial apparatus is put through heat runs, insulation, mechanical balances, frictional and commutating tests at the proper loads.

The requirements of the Bureau of Equipment, Navy Department, in regard to engine regulation, illustrate the severe conditions which have to be met in the construction of generating sets. The speed variation must not exceed 2½ per cent when the load is varied between full load to 20 per cent of full load, gradually or in one step, the engine running with normal steam pressure and vacuum. A variation of not more than 3½ per cent will be allowed when full load is suddenly thrown on or off the generator with constant steam pressure, either normal or 20 per cent above normal; a varia-

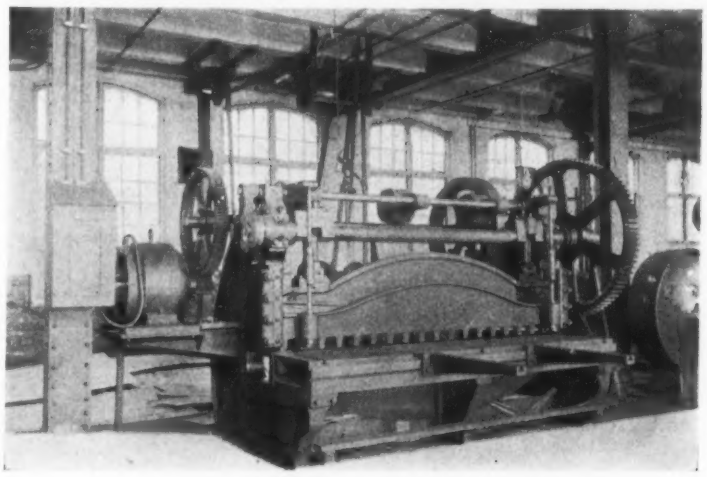


FIG. 7.—MOTOR-DRIVEN BLISS SHEAR.

tion of not more than 3½ per cent will be allowed when 90 per cent of full load is suddenly thrown on or off the generator, with constant steam pressure at 20 per cent below normal; exhaust in both cases to be either into condenser or atmosphere. No adjustment of the governor or throttle valve shall be necessary during the above test to insure proper performance under any of the above conditions. The maximum weight of generating sets allowed varies from 560 lbs. in the 2.5 kw size to 22,000 lbs. in the 100 kw size. The water consumption must not exceed per kw-hr. at full load 105 lbs., 2.5 kw sets, and 31 lbs. 100 kw sets. The maximum allowable temperature rise in degrees C. above a room temperature of 25° is:

Armatures, electrical measurement	33⅓ degrees.
Commutator, thermometer measurement	40 degrees.
Field coils, electrical measurement	33⅓ degrees.
Shunt rheostat, electrical measurement	75 degrees.
Series shunt, thermometer measurement	40 degrees.

The minimum allowable generator efficiencies vary as follows, from the 2½ to 100 kw sizes:

K.W.	50% load.	75% load.	Full load.	1⅓ load.
2½	73	76	78	78
100	87	89	90	90

The Bureau of Construction and Repair of the Navy has recently issued complete specifications covering electrical appliances on shipboard, and a noteworthy feature of these is the new shop test of motor-driven fans, which is, of course, in use at the Sturtevant works. This test provides that in shop tests the set shall be erected with free inlet to the fan. To the fan outlet must be attached a pipe the size and shape of the outlet, whose length shall be not less than 20 diameters of the outlet for fans with round outlets or 20 times the average breadth and depth for fans with rectangular outlets. A double Pitot tube, designed to indicate the pressure produced by the impact of the moving air and the actual pressure in the moving air shall be inserted in the center of this pipe at about ½ its length, with the axis of the tube in the center line of the pipe. An adjustable throttling device shall be fitted to the end of the pipe and adjusted with the fan running at its normal speed, with motor fields hot, until the pressure of motor, in inches, shown by a manometer connected to the pressure side of the Pitot tube is not less than 13.4 times the weight per cu. ft. of the air in lbs. When this condition is obtained, the head of water in inches shown by the manometer connected to the impact side of the Pitot tube shall not be less than 17.4 times the weight of the air per cu. ft. in lbs. (as

given by Bureau's tables). The wet and dry bulb thermometer must be placed in the current of air approaching the fan inlet. The object of this test is to show that the fan at full speed is capable of discharging air through a pipe the full outlet size against a pressure of 5 lbs. per sq. ft. with a minimum velocity of 2,200 ft. per min. at the center of the discharge pipe. The apparatus to record pressure direct, a pressure of 5.2 lbs. per sq. ft. is to be taken as equivalent to 1 in. of water. An 8-hr. heat run and 48 hr. endurance test follow.

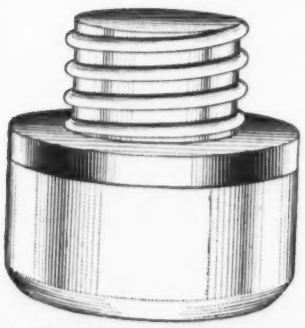
The architects and engineers for the B. F. Sturtevant Company were Messrs Lockwood, Greene & Company of Boston. The construction of the plant, including the design of the entire industrial equipment, the purchase of all building material, the hiring of all labor, was carried out by the Sturtevant company.

Eastern Hydro-Electric Plant.

The Chittenden Power Company's hydro-electric plant at East Pittsford is nearly completed. It will be one of the most complete stations of this class in western New England, and will cost $4,000,000. Three large turbines will be operated under a head of 208 feet and will drive three 40-kw. revolving field generators. The voltage will be 13,300. The Chittenden Power Company is allied with the Rutland Street Railway Company and one-third of the power developed at the new plant will be used in operating railway system, the remainder being available for commercial purposes. The system will include two sub-stations, one situated in East Pittsford, and the other at Castleton Corners, 12 miles away. At each sub-station the high-tension current will be reduced to 600 volts direct for the use of the railway. A Gould storage battery of 288 cells is also being installed in the sub-station in East Pittsford. The main generating station is a fireproof structure and is situated five miles east of East Pittsford. Each of the turbines is 72 horse-power, running at 500 r.p.m. Each is fed by a 30-in. penstock leading to a 5-ft. penstock from the dam. Pressure in the long penstock is hydraulically regulated by a cylindrical tank 15 ft. in diameter and 50 ft. long, situated on a steel tower 250 ft. high. The General Electric Company furnished all of the electrical apparatus.

The dam built at Chittenden, 15 miles east of East Pittsford, in connection with the plant, furnishes a head of 486 ft. The reservoir covers 800 acres, drains 15 square miles of territory, and has a capacity of 435,000,000 gallons. The masonry is 40 ft. high and has a spillway 100 ft. wide.

Weather-Proof Socket Plug.



WEATHER-PROOF SOCKET PLUG.

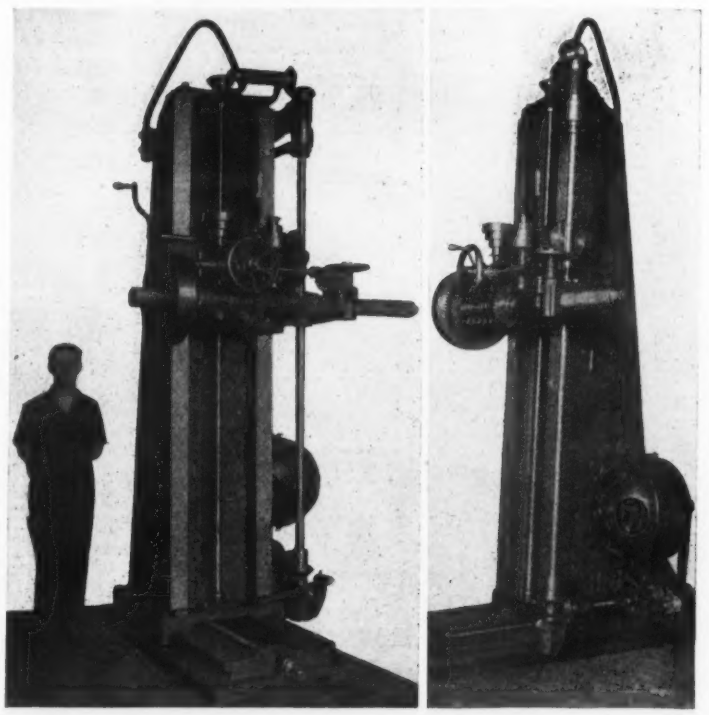
The socket plug shown in the accompanying illustration, has been designed as a substitute for an incandescent lamp in places where light is not needed throughout certain portions of the year, as in parks, summer resorts, and for sign work. Under ordinary circumstances when the lamps are removed, the sockets, which are left exposed to the elements, become badly corroded and cracked. The breakage resulting from this cause frequently amounts to a very large proportion of the total installation of sockets and receptacles, and the cost of new ones, together with the price of labor, necessary to replace them, forms a considerable item of expense. The socket plug illustrated is thoroughly weather-proof. A soft rubber gasket is interposed between the plug and socket, thus making an absolutely water-tight joint. These plugs are manufactured by the Weather-Proof Socket Plug Company, 1229 Real Estate Trust Building, Philadelphia.

Expansion Connection Carbon Brush.

Attention has recently been called to an improvement in carbon brushes, which is being introduced by the National Carbon Company, Cleveland, O. It is known as an expansion connection brush, and consists of a carbon brush, of any size, having a hole drilled into it, penetrating about one-half of the length of the brush. A piece of plaited flexible wire, terminating in a cable shoe, is unraveled at the end opposite to the cable shoe, and this miniature wire net is formed cylindrically around a little brass sleeve. This sleeve is of the same length as the hole in the carbon brush, and is slotted over two-thirds of its length. The slot is tapped so that the closing screw fitting into the slot is forced into a tapering hole. The resistance with which the screw meets on account of this tapering is overcome by the sleeve expanding, so that the whole appliance acts as a wedge when the screw is inserted, making a very close and rigid contact between the flexible wire and the interior of the brush, which is even increased through expansion of the metallic parts, should the brush become slightly heated while in use. This flexible connection is very easily detached, and can be connected to a new brush, simply by use of a screw driver, obviating the necessity of attaching by means of the soldering process. This connection is so arranged that the distance between the commutator surface and the terminal connection is reduced to a minimum, thereby reducing the carbon resistance between these points, resulting in obtaining a higher efficiency and a lower loss between the commutator surface and the end of the connection.

New Portable Boring, Milling and Drilling Machine.

The Espen-Lucas Machine Works, Philadelphia, have just put on the market several portable machine tools for use in large electrical manufacturing plants, one of which, a 72-in. portable boring, milling and drilling machine, is shown herewith. It is a very rigid and heavy tool, built to carry an 18-in., high-speed, steel, inserted-tooth cutter head. It has a very large range of speeds covering all the needful feeds for drilling small holes as well as boring large ones. The spindle, which is made of hammered crucible steel, is 4 in. in diameter



PORTABLE BORING, MILLING AND DRILLING MACHINE.

and feeds through a gun metal sleeve, having 24 in. of feed. It has a No. 6 Morse taper hole in the end, and also a pin hole for retaining the bars and milling tools in place. The head has a vertical adjustment of 72 in. and can be securely clamped in any position for milling. The column carrying the spindle head has feed in both directions, giving 24 in. to the spindle-head for milling. The spindle has feed in either direction for boring and counterboring, and is very powerfully geared for heavy work. The machine shown in the cut is driven by a 3 to 1 variable-speed Crocker-Wheeler motor. The gearing is made of hammered crucible steel cut from the solid and the bearings are all lined with bronze.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Most favorable reports were made from all sections, and the sentiment in jobbing trade and the industries was more uniformly favorable than during any previous week this year. Crop reports are reassuring, the absence of frost being the favorable feature. Fall trade is now well under way and mercantile payments are unusually prompt for the season. Manufacturing plants in the leading industries are receiving large orders, a heavy tonnage of iron and steel business being placed, and machinery houses make very cheerful reports. As grain comes to market more freely there is difficulty in averting freight blockades, and railway earnings thus far available for September exceed last year's by 2.5 per cent. Foreign commerce at the port of New York for the last week showed a gain of $532,846 in imports, but a loss of $4,068,163 in exports. Bank exchanges at New York were 21.6 per cent larger than a year ago, and at other leading cities the gain averaged 10 per cent. Building material, particularly lumber and hardware, still reflects unprecedented activity for this season of the year. Labor is well employed, and reports of a scarcity of help come from widely separated points. Chicago had the banner week of the year in jobbing trade; St. Louis reports trade exceeding that of last year, and at Indianapolis the outlook is reported as highly satisfactory. On the Pacific coast trade is at its best, and the activity in railroad building in that section stimulates demand for labor. The copper market is still dull and without animation, but some brokers were able to secure fair size contracts at the ruling figures of 16 to 16½c. for Lake and electrolytic, and 15¾c. for casting stock. The business failures for the week ending September 21, according to *Bradstreet's* figures, were 173 against 188 the week previous and 203 in the corresponding week last year.

OCEAN SHORE RAILWAY.—The Ocean Shore Railway Company, which recently let contracts to C. E. Loss, of New York, for the construction of its 81-mile double track electric railway, connecting Santa Cruz with San Francisco, is in the market for the electric equipment of its initial installation. The call for proposals issued by Sidney Sprout, the company's electrical engineer, includes 40 car equipments of four 125-hp direct current motors each, multiple control system. The sub-stations call for ten 500-kw, 25-cycle, rotary transformers, 550 to 650 volts on direct current side, and thirty 250-kw static transformers. Eight of the sub-stations will be located at points on the line according to the load, while two will be mounted on cars so as to be portable. One rotary and three static transformers will occupy each sub-station. The main power station will be erected at Balboa, a new town, one mile north of Halfmoon Bay, near the water, so that a salt water pumping system can furnish condensing water for the engines. Two 2,000-kw, three-phase, 2,300-volt, 25-cycle generators are called for, each to be direct-connected to a vertical condensing engine. Seven step-up transformers, to 30,000 volts, will be required, three to each generator and one extra. There is an alternative of three 1,500-kw generators with three engines, and ten 750-kw transformers. Switchboards for generating and sub-stations are to be included in the proposals, as well as exciters and auxiliaries. Water-tube boilers are specified, equipped for burning oil fuel. The company's capital stock is $5,000,000, and the road when completed and fully equipped will represent an expenditure of nearly $6,000,000, it is said. W. E. Dean is president and A. D. Bowen, general manager of the company, which occupies an office building at 561 California Street, San Francisco.

CHICAGO PNEUMATIC TOOL.—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has returned from Europe. He states that the foreign business promises, during the next few years, to rival the American business. The American factories are all running to their maximum capacity night and day, and although a number of the latest improved automatic machines have recently been installed at each factory, they are unable to keep pace with the business offering, and further improvements are to be made at an early date. Mr. Duntley brought home with him orders for several hundred air cooled Duntley electric drills. The bulk of the orders for electric drills are coming from fields heretofore impossible to interest in the air tools. While he was in England and on the continent several tests were made with the result that the sample tools demonstrated by Mr. Duntley accomplished the work in a satisfactory manner. Domestic inquiries are extremely heavy for all classes of tools and appliances, as well as compressors, as many as forty compressors being quoted upon in a single day. Several large orders for compressors and tools have been received recently.

RUSSIAN ELECTRICAL TRADE.—The removal of retaliatory duties on American imports has already proved a great stimulus to American trade here. The agents of American houses have wired directions for the shipment of engines, pumps and other machinery. This prompt action of the agents is necessary in order to land goods at Cronstadt before the close of navigation, so as to avoid the heavy costs of railroad trans-shipment from the ice-free ports in the southern Baltic, and also in order to take advantage of the favorable rates under existing treaties, as before navigation is reopened the new and higher scale of duties based on the treaty recently made with Germany will be in effect. This treaty provides increases ranging from 10 to 20 per cent on machinery. The manufacturers of electrical machinery, expect that export business will be greatly benefitted by the recent order of the Czar. An official of the Westinghouse Electric & Manufacturing Company states that the return of peace will allow a large number of Russian projects, which were on foot before the war, such as the electrification of the St. Petersburg street railways, to be renewed, and that American concerns should get a large share of the business. Heretofore, German and Swiss firms have been generally the successful bidders in this field.

EQUIPMENT FOR APARTMENT HOTEL.—A twelve-story annex, 64 ft. front by 100 ft. deep, is to be built to the Hargrave Hotel, 104 West 72d Street, New York City. The Oak Realty Company is the owner; Frederick C. Browne, 145 West 125th Street, is the architect. Percival Robert Moses, electrical engineer, 320-322 Fifth Avenue, has been retained as consulting engineer. The present steam, electric and refrigerating plant of the Hargrave will be reinstalled in a central location to supply the two buildings, and additional equipment of one 100-hp boiler, one 13 in. x 12 in. simple automatic high-speed horizontal engine, direct-connected to a 60-kw compound-wound multipolar direct current, 240-volt generator, with 50 amp. shunt-wound motor-dynamo balancer, and two passenger elevators will be installed.

CHARLES E. DUSTIN COMPANY, dealer in electrical and steam machinery, 11 Broadway, New York, with storehouses located formerly at Orangeburg, N. Y., has secured the large works formerly occupied by the Spiral Riveted Tube Company, Fiske and Mallory Avenues, Jersey City, N. J., together with all the buildings. It has moved all its material from Orangeburg, the new works having been fully fitted for the purpose of handling and storing electric generators, steam engines, boilers and all forms of electrical and steam machines. There are four buildings and about 1½ acres of land, reached directly by a side track of the Central Railroad of New Jersey.

ELECTRICALLY DRIVEN PUMPS.—Chief Engineer De Verona of the Department of Water Supply has reported to Commissioner Oakley in favor of the D'Olier Engineering Company, which was the lowest bidder for the eight electrically driven pumps for the high-pressure fire service stations in course of construction in Brooklyn. Five of the pumps are for the station at Joralemon and Furman Streets and three for the station at Willoughby and St. Edwards Streets. A protest against the award on the ground that the D'Olier Company is a foreign corporation was overruled.

NEVADA MINING POWER PLANT.—The Allis-Chalmers Company will supply two 750-kw three-phase generators and direct-connected engines; also a large blowing engine to supply air to the roasting furnaces for the boiler plant of the Nevada Consolidated Copper Company's electric mining installation at Ely, Nevada. Chas. C. Moore & Company, of San Francisco, have secured the contract for four 400-hp Babcock & Wilcox boilers, with condensers, economizers and superheaters.

TELEPHONY IN NEW YORK.—The increase in the number of stations which the New York Telephone Company had in use or under contract for the month of August was 4,456. The total number of stations in use in the five boroughs of New York was 220,155. This gives about 55 telephones to 1,000 inhabitants. The average for the country is about one telephone per 34 persons.

THE COLUMBIA BATTERY COMPANY has recently been organized at Milwaukee, Wis., to manufacture storage batteries, by a new process. The batteries have been in use in Milwaukee for some little time and have given such excellent service that it has been determined to exploit the cell. The office of the company is at Third and State Streets, the capital stock being $10,000.

APPARATUS FOR CHILI.—The Compania de Luz Electrica de Concepcion, of Concepcion, Chili, Arturo Lotzin, manager, wishes to get catalogues, price lists and discount sheets of electrical apparatus, fittings, machinery, turbines, carbons, etc.

DEMAND FOR MECHANICAL STOKERS.—That the mechanical stoker has reached such a state of perfection as to be considered indispensable in the equipment of most modern boiler plants is indicated by the large number of orders booked by the Westinghouse Machine Company for the Roney stoker, a type of its exclusive manufacture. In ten years this company has developed the Roney stoker by successive improvements until it has become capable of meeting successfully all the requirements of heavy modern service. During the past month orders have been received for no fewer than 51 Roney mechanical stokers, ranging in size from 54-in. x 20 grate to 132-in. x 26 grate, the largest of the orders being that of the Pennsylvania Railroad for six 132-in. x 26 grate stokers and five 100-in. x 20 grate stokers. A large order from the Ohio Hospital for Epileptics at Gallipolis has also been received; and others from the American Bridge Company, Ambridge, Pa.; National Tube Company, Pittsburg, Pa.; Detroit United Railway Company, Detroit, Mich.; York Engineering Company, York, Pa.; Proctor & Gamble Company, Cincinnati; the Union Rolling Company, Cleveland, O.; Gulfport & Mississippi Coast Traction Company, Gulfport, Miss.; United Presbyterian Board of Publication, Pittsburg, Pa.; Indiana Boys' School, Plainfield, Ind.; B. & O. office building at New York City, and the Railway Exchange Building at Chicago, Ill.

BIDS FOR NAVY SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until October 10, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., dynamotors, motors, conduit, testing sets, electrical supplies, rheostats, etc.; also October 17 at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motor, electric wire and fittings, conduit cable, motor drive outfit, electric traveling hoist, air hoist, steam separator, windlasses, etc.; also October 31 at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motors, wattmeters, electric traveling crane, electric traveling hoists, pumps, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has been incorporated to manufacture all kinds of electrical machinery and apparatus. The officers are: E. Shideler, president; E. N. Laralde, vice-president; L. K. Behrens, secretary and treasurer, and C. H. Haddrell, general manager. The Barriett Electric Manufacturing Company has succeeded to the business of the Barriett Electric Company, and will continue the manufacture of motors and generators. The business will be considerably extended. Direct coupled motor-driven blowers and buffing lathes have now been added to the standard lines manufactured.

CALIFORNIA TRANSMISSION.—H. H. Sinclair, of the Edison Electric Company, of Los Angeles, has gone East and will make a tour of the leading manufacturing plants before closing contracts for the long transmission line from the Kern River to Los Angeles. It is proposed to have about 1,100 steel towers, many of which will be 60 feet in height, to support the wires. Thirty thousand horsepower will be developed, there being a head of 825 feet at the power house site.

UNDERGROUND CABLE BIDS.—Bids will be received by the Committee on Electricity of the Common Council and Board of Aldermen, Lynchburg, Va., until October 9, for the manufacture and delivery of underground, alloy-covered cables for the electric signal circuits of the fire department and police patrol systems. For further particulars apply to W. L. Kent, city electrician.

LAVA INSULATORS IN CANADA.—The D. M. Steward Manufacturing Company of Canada, Toronto, has been incorporated with a capital of $40,000, to manufacture gas burners, electrical insulators, crayons etc. The provisional directors include C. S. Steward, of Chattanooga, Tenn.; W. H. Frazier and S. L. Ezell, of Toronto.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for telephone exchange switchboards for the following places: Marathon, Wis.; Rose Hill, N. Y.; Watson, Mo.; Tolo, Oregon; Niagara Falls South, Ont., Can.

THE SOLVAY PROCESS COMPANY, Syracuse, N. Y., is to install a unique air heater in the form of a special economizer built by the B. F. Sturtevant Co., of Boston, Mass. This is designed to heat nearly a million cubic feet of air per hour from about 70° to 600° F.

LAMP BIDS.—Bids will be received until October 5 by M. C. Martin, chief quartermaster, U. S. A., for furnishing and delivering at Chicago 55,000 incandescent electric lamps.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was generally strong under bullish manipulation, the leading railroad shares showing decided strength. United States Steel stocks were active and were freely bought. The actual developments of the week, apart from the additional gold importations, did not have any particular influence on prices. There was little disposition to take up the railroad specialties and that portion of the list suffered somewhat from such neglect. The electric securities received little attention and were quiet throughout the week. Brooklyn Rapid Transit was the only exception in point of activity, 104,800 shares having changed hands at prices ranging between 68⅜ and 71⅜, the closing price being 70½. This is a net gain of 1⅛ points. Metropolitan Street Railway fluctuated between 126¾ and 129, closing at 128⅜, a net gain of ½-point, while Interborough Rapid Transit declined a like amount, closing at 213½ ex-div. Allis-Chalmers common made a net gain of ½, closing at 17¾, but preferred is unchanged at 58. General Electric touched 183 during the week, but lost some of the gain and closed at 179½, which represents a net loss of ⅜-point. Westinghouse common is at 170, an increase of 4 points. Western Union is a shade lower and American Telephone & Telegraph 2½ less than a week ago, the closing prices being 93¼ and 140, respectively. American Telegraph & Cable sold at 93, a net gain of 3¾. Prices on the "Curb" were generally higher compared with the week before. There was a break in Chicago Subway due, it is supposed, to efforts to distribute stock for which there is apparently not much public demand. Following are the closing quotations of September 26:

NEW YORK

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
Allis-Chalmers Co.	17¾	18⅛	General Electric	180¼	182
Allis-Chalmers Co. pfd.	5⅛	5¾	Hudson River Tel.	..	..
American Dist. Tel.	30	30	Interborough Rap. Tran.	215	212
American Tel. & Cable	92	92	Mackay Cos.	41⅛	43
American Tel. & Tel.	139	138	Mackay Cos. pfd.	74⅜	74¼
Brooklyn Rapid Transit	68⅝	72	Marconi Tel.	..	..
Electric Boat	30	30	Metropolitan St. Ry.	126⅞	125⅞
Electric Boat pfd.	70	70	N. Y. & N. J. Tel.	..	..
Electric Lead Reduction	..	..	Western Union Tel.	94½	93¼
Electric Vehicle	18	17	Westinghouse com.	167	169¼
Electric Vehicle pfd.	23	22	Westinghouse pfd.	..	..

BOSTON

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
American Tel. & Tel	139	140⅛	Mass. Elec. Ry. pfd.	58⅛	56
Cumberland Telephone	120⅛	119⅛	Mexican Telephone	1¾	1¾
Edison Elec. Illum.	250	247½	New England Telephone	134⅛	136
General Electric	179	181	Western Tel. & Tel.	*18	16
Mass. Elec. Ry.	15⅛	14	Western Tel. & Tel. pfd.	97	97

PHILADELPHIA

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
American Railways	52	52⅛	Phila. Electric	8¾	8⅞
Elec. Co. of America	11	11	Phila. Rapid Trans.	28	27½
Elec. Storage Battery	85	85	Phila. Traction	..	100¾
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
Chicago City Ry.	190	195	National Carbon	60	60
Chicago Edison	..	..	National Carbon pfd.	115½	114⅛
Chicago Subway	..	..	Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd.	..	..
Metropolitan Elev. com.	25	25¼			

* Asked.

INTERBOROUGH INCOME.—The Interborough Rapid Transit Company, which operates the subway and the Manhattan elevated lines in New York, has issued its report for the year ended June 30, at which time the subway had been in operation eight months and five days. The net earnings for the year were $9,439,986, an increase of $1,098,352 as compared with last year, when only the elevated lines were operated. The gross earnings were $16,837,370, an increase of $2,649,685; operating expenses, $7,379,384; increase, $1,551,333; net earnings, $9,439,986; increase, $1,098,352. Other income amounted to $491,040, an increase of $149,536. Expenditures for interest and rentals aggregated $2,443,371, an increase of $621,191. The dividends of $2,362,500 on Interborough stock for 1905 showed an increase of $1,662,500. Operating expenses increased from 41.20 per cent to 43.93 per cent.

NILES-BEMENT-POND.—Negotiations have been carried through for the acquisition by the Niles-Bement-Pond Company of the plant and business of the John Bertram & Sons Company, Limited, of Dundas, Ont. About $300,000 will be spent in improvements to the property. The common stock of Bertram & Sons, as increased from $200,000 to $400,000, will all be owned by the Niles-Bement-Pond Company. The 6 per cent cumulative preferred stock will be increased about October 1 from $100,000 to $200,000, and, it is understood, will be held by the public, the new shares, of a par value of $100, having all been subscribed.

INDEPENDENT TELEPHONY.—A certificate showing increase of capital stock from $500,000 to $50,000,000 by the New York Independent Telephone Company has been filed at Albany. The stockholders signing the certificate, which is acknowledged in Monroe County, are Harrison C. Durand, Harry C. Sickels, William F. Dwyer, J. Henry Howe, Arthur C. Frith, George S. Bixby and George R. Fuller.

INDEPENDENT TELEPHONE CONSOLIDATION.—In connection with the tour of independent telephone men, an account of which was given in last issue, comes the statement from Rochester, N. Y., that the consolidation of independent telephone interests from the Atlantic to the Pacific is practically assured. Rochester men will take a prominent part in the deal, and the Stromberg-Carlson factory in that city, it is stated, is to be the headquarters for their apparatus for the entire country. Circulars have been mailed by the Alliance Bank, Rochester, to all the stockholders of the Stromberg-Carlson Company and of the Rochester Telephone Company, outlining the plan of consolidation with the United States Telephone Company of New Jersey, which has been organized as the "holding company," to take over control of all of the independent telephone companies in the United States. The capital stock of this company is stated to be $50,000,000. Bonds will be issued to cover the cost of every independent plant in the United States included in the scheme. Information comes from St. Louis to the effect that the consolidated interests will establish a factory plant in that city similar to the one in Rochester, from which the Western section of the United States will be supplied with apparatus, the Rochester factory taking care of the supply in the Eastern section. The St. Louis company, it is stated, will have a capital of $5,000,000.

NEW HAVEN RAILROAD BONDS.—The New York, New Haven & Hartford Railroad stockholders of record on Dec. 1, 1905, will have the right to subscribe to an issue of convertible debenture certificates amounting to $30,000,000 in the ratio of $37.50 par for each share of stock held by them. Payments are to be at the rate of 35 per cent, beginning Jan. 1, 1906, and 25 per cent at the end of each nine months thereafter. The debentures at a par of 150 will be convertible five years from the date of issue for stock of the company at a par of 100. The purpose of the plan is to retire temporary obligations of the company and to absorb the outstanding securities of subsidiary lines. As a result of this new issue of debentures the stock of the company, five years after the issue, will be raised from $80,000,000 to $100,000,000. Among the improvements recently undertaken by the New Haven is the electrification of the New York end of its main line in connection with the similar improvement undertaken by the New York Central. Much work has also been done on the New Haven's main line between New York and New Haven. Practically all the bridges on this section of the road are being reconstructed. It was found that the bridges were unable to bear the heavy traffic carried over the road, and heavier steel bridges are being substituted. The New Haven has spent recently large sums in the purchase of electric lines which at many places competed with it for local traffic.

SAN FRANCISCO GAS & ELECTRIC.—The directors of the San Francisco Gas & Electric Company have undertaken to place all of the shares of that company with the Union Trust Company, to be held in escrow until the purchase is completed. The purchasers, who are said to be connected with the Rockefeller group of interests, have deposited $500,000 with the Trust Company as a guarantee that they will carry out their part of the contract. The price to be paid is said to be $25 cash and $65 in 5-per cent bonds for each share of the gas company's stock. At the rate of $90 per share, the purchasers will pay for the 158,484 shares $14,263,560, of which $3,962,100 is in cash and $10,301,460 in bonds. When the negotiations were commenced the shares were selling at about $54 and the price steadily advanced until it reached $80 recently. There were some sales at $80.75. By placing the stock in escrow the necessity of holding a special meeting of the stockholders and securing a two-thirds vote in favor of the sale is obviated. What position the Mutual Electric Light Company will take cannot be stated yet, although the advance in its shares has led to reports that some of its stockholders were in favor of taking up a merger proposition.

DIVIDENDS.—The Central & South American Telegraph Company has declared the regular quarterly dividend of 1½ per cent. The Mexican Telegraph Company has declared the regular quarterly dividend of 2½ per cent. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred and the assenting and non-assenting stocks, payable October 10. The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable November 1. The American Telephone & Telegraph Company directors have declared the regular quarterly dividend of 1½ per cent, payable October 16. The regular quarterly dividend of 1¼ per cent on the preferred stock of the United Railroads of St. Louis has been declared, payable October 10. The directors of the Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent on both stocks, payable October 2. The Union Switch & Signal Company's directors have declared the regular quarterly dividends of 2 per cent on the common stock and 2½ per cent on the preferred stock, both payable October 10.

HUDSON RIVER TUNNEL RAILWAY.—The Newark & Hackensack River Railway Company and the Hackensack River Railway Company, each affiliated with the scheme to tunnel the Hudson River between New York and Jersey City, have been incorporated. Each of the companies has an authorized stock of $1,000,000 and the incorporators of each are the same. They are Thomas N. McCarter, president of the Public Service Corporation; Charles A. Sterling, East Orange; Albert H. Charlton, Elizabeth; John J. Burleigh, Merchantville; Anthony R. Kuser, Bernardsville; Thomas C. Barr, Orange, and Mark T. Cox, East Orange. The Newark & Hackensack River Railway Company is to construct a trolley line from Park Place, Newark, to the Hackensack River. The Jersey City & Hackensack River Railway Company is to continue the line from that point to the intersection of Erie and Fourteenth Streets, Jersey City, where it is to connect with the proposed line of the Interstate Tunnel Railway Company, which in turn is to construct the tunnel to the middle of the North River connecting with the affiliated company incorporated in New York State. Lew Bloom and Jane Cooper, presenting their original playlet, "A

ANNUAL REPORTS.—Following are condensed reports of three of the Stone & Webster properties for the year ending July 31, 1905: Edison Elec. Illum. Co., of Brockton, Mass.; gross earnings, $134,493.71, increase, $22,965.89; operating expenses, $93,033.32, increase, $130,730.07; net earnings, $41,460.39, decrease, $7,764.18; interest charges, $8,651.52, decrease, $4,855.15; net profit, $32,808.87, decrease, $2,909.03. Lowell Electric Light Corporation, Lowell, Mass.: Gross earnings, $248,127.24, increase, $14,939.50; operating expenses, $146,738.80, increase, $4,602.73; net earnings, $101,388.44, increase, $10,336.77; interest charges, $11,333.66, decrease, $5,074.54; net profit, $90,054.78, increase, $15,411.31. Minneapolis General Electric Company, Minneapolis, Minn.: Gross earnings, $695,825.11, increase, $97,059.68; operating expenses, $346,405.01, increase, $31,849.44; net earnings, $349,420.10, increase, $65,210.24; interest charges, $112,823.27, decrease, $3,583.51; net profit, $236,596.83, increase, $68,793.75.

ELECTRIC REFINING DEAL.—It is stated from Philadelphia that the reported lease of the copper plant of the Lake Superior Corporation to the Canadian Nickel Company, a concern organized for the purpose of refining copper and nickel by electricity, has been confirmed by Francis B. Reeves, a Philadelphia director of the corporation. Regarding the lease Mr. Reeves said: "While the corporation should have really received $2,000,000 from the Canadian government it really received but $1,000,000. Although the credit of the corporation is excellent it did not seem wise at this time to take money from the steel and pulp mills which are doing excellently to develop the copper and nickel refining process, and it has closed a lease with the Canadian Nickel Company, made on favorable terms for the Lake Superior Corporation."

BOSTON EDISON REPORT.—The Edison Electric Illuminating Company, of Boston, has filed its annual report with the gas and electric light commissioners. The financial operations for the year ended June 30, with comparisons, are here given:

	1905.	1904.	1903.
Gross	$3,346,027	$3,125,517	$2,667,809
Expenses	2,177,974	2,055,756	1,418,456
Net	1,168,052	1,069,761	1,249,353
Other income	100,876	138,325	35,549
Total net	1,268,928	1,208,046	1,284,962
Charges	182,824	203,338	188,554
Balance	1,086,104	1,004,708	1,096,348
Dividends	1,070,770	973,405	804,667
Total surplus	67,508	71,934	352,632

BELL TELEPHONE BONDS.—It is stated from Boston that President F. P. Fish, of the American Telephone & Telegraph Company, and Robert Winsor, of Kidder, Peabody & Company, have been together in London and that this conference has some connection with the future financing of the American Telephone Company. It will be recalled that when the company issued its $25,000,000 4 per cent bonds last March, $10,000,000 of these bonds were sold abroad and they have not been resold to this country. Europe will be looked to in the future to help finance the telephone company's development, which is now taking place at a greater rate than ever.

CAMBRIDGE, MASS., LIGHT.—The report of the Cambridge Electric Light Company for the year ended June 30, compares as follows:

	1905.	1904.	1903.
Gross	$233,108	$225,510	$198,062
Net	112,061	97,978	55,185
Dividends	56,000	36,000	31,500
Surplus	56,061	61,979	23,685
Charges	22	42,149	13,254
Surplus	56,039	19,830	10,431

INVESTMENTS IN JAPAN.—According to reliable statistics, the amount of foreign capital invested in Japanese industries at the beginning of the war was only $1,000,000. The Tokio Electric Light Company and the Hokkaido Colliery & Railway Company have respectively successfully negotiated foreign loans of $1,500,000 and $5,000,000.

General News of the Week

The Telephone.

NEW CASTLE, ARK.—The Mercantile Telephone Company, of New Castle, St. Francis County, has been incorporated with a capital stock of $17,000. The names of the officers are: President, F. J. McDougal; vice-president, W. J. Dillon; secretary and treasurer, E. L. Horton.

TEXARKANA, ARK.—The Southwestern Telegraph & Telephone Company at a meeting of the City Council on the Arkansas side formally accepted the franchise granted by the city for operating and extending its business in this city and vicinity. One of the specifications in the franchise is that all wires in the business part of town must be put underground.

CALISTOGA, CAL.—A telephone franchise has been granted to C. M. Hoover.

SONORA, CAL.—The Standard Lumber Company has decided to install a dynamo to supply the town with electric light during such time as the water power may be shut off.

SAN FRANCISCO, CAL.—The consideration of the Alameda Home Telephone Company's application for a franchise has been postponed until Sept. 25 by the City Council of Oakland. A committee will be sent to Los Angeles to look into the operation of the Home Telephone Company's automatic system there before that date. Attorney J. J. McDonald, representing capitalists of other cities, has filed an application for a franchise, offering to invest $900,000 within three years and agreeing to pay to the city 3 per cent of the gross receipts after three years.

EAST ST. LOUIS, ILL.—The Bell Telephone Company has started excavating for the foundation of the new telephone exchange and office building at Eighth street and Missouri Avenue. This will be the second building to be erected by the Bell company in East St. Louis.

AURORA, ILL.—At the annual meeting of the Interstate Telephone & Telegraph Company, held Sept. 11, the seventeenth regular, quarterly dividend of 1 per cent was declared on the entire capital stock. The report for the fiscal year ending June 30, showed an increase of nearly $20,000 in the surplus over and above fixed charges, including interest and dividends.

SHIRLEY, IND.—Elam Leary, of this city, and others have purchased all the property and rights of the Shirley Telephone Company.

SOUTH BEND, IND.—The City Attorney has brought suit against the Independent Long Distance Telephone Company and the Western Union Telegraph Company to enforce an ordinance requiring all wires to be placed under ground and to collect a penalty of $25 to $100 per day since June 1. It is claimed that all other telephone and electric light companies have complied with the ordinance.

DARLINGTON, IND.—The Cooperative Telephone Company, of Franklin and Sugar Creek townships, has consolidated with the Home Telephone Company, of Darlington. The latter is supposed to be owned by the Bell interests. This will give the Bell subscribers access to the Cooperative, but for the present at least the Home Telephone Company, of Crawfordsville, will continue to connect with them also.

INDIANAPOLIS, IND.—Three new telephone companies have filed articles of incorporation with the Secretary of State. The Home Telephone Company, of Flora; H. E. Soesbe, H. E. and Joseph Studebaker are the incorporators. The Home Telephone Company, of Hancock County. The headquarters will be in Greenfield. A. T. Reevey, M. E. Dobbins and S. A. Wray are the incorporators. The Citizens' Telephone Company, of Shirley; W. B. Thompson and Harry Griffith are the incorporators.

KOKOMO, IND.—The Citizens' Telephone Company has endeavored for some time to get its franchise amended so as to remove the prohibition to enter into a combination with the Bell Telephone Company. Failing in this the company has served notice of an increase of 25 cents a month on resident telephones; also that subscribers will be required to pay quarterly in advance. The rate on residence telephones has been $1.25 a month ever since the system was installed. The franchise under which the company operates grants the right to charge $1.50 a month for residence telephones, and this may have to be submitted to, but the payment quarterly in advance will be bitterly oposed.

FORT WAYNE, IND.—Following out the plan of organization adopted at the Winona meeting, July 12, when the Indiana Independent Telephone Association was organized, several districts have held meetings. The representatives of this, the Second district, held a meeting here on Sept. 12, the Tenth district at New Albany on Sept. 18, and the Ninth district at Princeton on Sept. 20. These meetings were all well attended and much interest manifested in the plan of organization. The meeting of the Seventh district will be held in Indianapolis, Sept. 27, and that of the Eighth district at Cambridge City, October 12. The State Association has eleven vice-presidents, each one of whom is president of his district association. George W. Beers, of Fort Wayne is president, and C. S. Norton, of Indianapolis, secretary of the State Association.

MARION, IND.—There was formed in this city on Sept. 21 a new combination of independent telephone interests, including the Converse Telephone Company, Winchester Telephone Company, Delaware & Madison County Telephone Company, of Muncie, and the Home Telephone Company, of Fort Wayne—four of the strongest telephone companies in Northeastern Indiana. Some of the most prominent men of the State are interested in the new combination. It is the purpose of the new organization to ask a franchise in Marion and to establish a plant here in opposition to the Central Union and United Company now operating under the Bell management. The Converse company has a toll line reaching Marion and maintains a central office, but has no general franchise in the city. A new copper wire circuit is being put up between Converse and Indianapolis at the present time, and the Converse Company has connected up Wabash, Peru, Greentown, Sims and other cities with copper circuits. These developments coupled with the purposes of the new combination is regarded as the beginning of a lively telephone war against the Central Union by the independents in northern Indiana.

BARNUM, IA.—The Barnum Telephone Company, capital $10,000, has been formed by P. T. Burke and others.

ARDMORE, I. D.—The Sulphur telephone system has been sold by C. J. Webster and J. D. Kirby to W. N. Hayes, of Norman, Okla., and J. F. Rumley, of Chicago.

FENTON, MICH.—Propositions from two telephone companies for the purchase of its system are being considered by the Fenton Mutual Telephone Company.

BRISTOL, MICH.—The Osceola-Lake Co-operative Farmers' Telephone Company has been organized. C. M. Van Antwerp is president; M. O. Stroud, secretary; Fred Darlington, treasurer.

BATTLE CREEK, MICH.—The Michigan State Telephone Company has nearly completed its rural telephone service out of this city. The company has placed 300 telephones in farmers' houses, making in all 500 instruments on the rural lines covering the country within a radius of eight miles. Free service is established between the city and the country subscribers.

NORTHVILLE, MICH.—The Northville Telephone Company at its annual meeting elected the following officers: President, Dr. J. M. Burgess, vice-president, F. S. Neal; secretary and manager, M. A. Porter; treasurer, R. C. Yerkes. A dividend of 10 per cent was declared. The company has over 200 telephones and more than 150 miles of line. It gives long-distance connections with all parts of the State.

LANESBORO, MINN.—The Northwestern Telephone Company is contemplating the installation of a local exchange here.

MINNEAPOLIS, MINN.—The Tri-City Telegraph and Telephone Company has asked the City Council for a franchise to construct a telephone exchange in this city.

ST. LOUIS, MO.—The approximate number of subscribers to the Bell Telephone service in the city of St. Louis is now put at 25,000, which is the largest in the history of the company. Despite sharp opposition on the part of the local independent, there has been a considerable gain right along in the amount of business done by the local Bell corporation.

SKILLMAN, N. J.—The State Village of Epileptics is having installed a complete telephone system connecting the administration building with the cottages and farm buildings.

JAMESTOWN, N. Y.—Thad S. Lane, of Jamestown, N. Y., has secured a controlling interest in the stock of the Home Telephone Company of this city. This company was organized about three years ago by Warren people. The controlling interest has since been held in Warren, but it is understood now passes into the hands of a syndicate which has invested several millions in independent telephone properties.

ASHEVILLE, N. C.—A. Wynne, of Raleigh, N. C., has secured a franchise to install and operate an independent telephone system.

BISMARCK, N. D.—The Capitol Telephone Company has been formed with a capital of $100,000, by I. P. Haker, Alexander, McKenzie and others.

FLORA, OHIO.—The Home Telephone Company has been formed with a capital of $5,000 by H. E. Soeshe and H. E. Studebaker.

ELMIRA, OHIO.—The Northwestern Mutual Telephone Company has been organized with a capital of $10,000, by J. H. Ferrel and J. F. Reeves.

TOLEDO, OHIO.—The directors of the Toledo Home Telephone Company have decided to increase the wages of all its operators about 10 per cent. The directors also declared the customary 1 per cent quarterly dividend.

CHARTIERS, PA.—The Chartiers Telephone Company is arranging for the construction of a new line from Buffalo village to Taylorstown, where connections will be made with the Claysville Telephone Company's lines. The same company is also arranging for the construction of a new toll line between Canonsburg and McDonald. Connections will be made at Canonsburg with both the State Mutual and Wheeling and Pittsburg Telephone Companies.

PIERRE, S. D.—The Great Western Telephone Company, of Chamberlain, has been formed with a capital of $25,000, by Warren Young and David Henry.

PIERRE, S. D.—The telephone trouble which has been on at Pierre some time between the local exchange and the Dakota Central has been ended by the purchase of the local exchange by the Dakota company. The purchase is made to secure better local service for the Dakota Central, and to give it a base for western extensions. The two systems have been reconnected.

BEAUMONT, TEX.—Judge W. H. Pope has appointed John W. Mackey, of this city, temporary receiver for all the properties of the Beaumont Northwestern Telephone Company.

PRICE, UTAH.—The Eastern Utah Telephone Company has been formed with a capital of $50,000. Reuben G. Miller, President.

ABINGDON, VA.—The East Tennessee Telephone Company contemplates building a metallic line between Abingdon and Bristol.

CHIPPEWA FALLS, WIS.—The Yellow River Telephone Company has been formed, with a capital of $10,000, by D. McElmurry, of Colburn, and others.

Electric Light and Power.

MENA, ARK.—The Mena Light, Heat & Power Company has been incorporated with a capital stock of $250,000.

UKIAH, CAL.—A franchise for an electric transmission line from this city to Potter has been sold to the Eel River Power and Irrigation Company, for $50, this being the only bid.

HANFORD, CAL.—It is stated that arrangements have been made with the San Joaquin Power Company to extend its electric transmission line down to Corcoran. The line will be 17 miles in length.

OAKLAND, CAL.—The Oakland Gas, Light and Heat Company has given notice that it is securing rights of way to skirt the city with its 40,000-volt transmission wires, instead of carrying the high current through the streets, as at present. Plans of details for putting other overhead wires in conduits are being rapidly shaped.

ROCKVALE, COL.—The Council has granted the Arkansas Valley Electric Light Company a franchise to construct and operate an electric light plant.

WINDSOR LOCKS, CONN.—The Windsor Locks Electric Lighting Company is to increase its water power by lowering the tail race between the wheel pit and the river. The effective fall at the wheel will be increased by nearly eight feet, and this will give about 50 more horse-power. New transformers for house and store lighting will be put in at once in order to utilize the power thus gained.

KEY WEST, FLA.—An ordinance has passed first reading, granting to Messrs. Ladd, Larkins and Jerguson a franchise to furnish electric light to Key West.

ROCKMART, GA.—The Rockmart Electric Light, Power & Water Company has decided to petition council for a franchise to construct an electric light plant. A. H. Graefer is secretary.

WASHINGTON, GA.—The Anthony Shoal Power and Mill Company has been bought by John H. Fitzpatrick, of Washington, who propses the immediate development of the same and possibly the later construction of an electric railway from Washington to Elberton, Ga. The power will be used for manufacturing purposes.

LA GRANGE, GA.—Contracts for constructing the municipal electric light plant have been awarded as follows: Two boilers and stack, to the Lombard Iron Works, Augusta; two engines, to the Ball Engine Company, Erie, Pa.; two generators, to the Crocker-Wheeler Company, Ampere, N. J.; switchboard and arc lamps, to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., and the pole line and wiring to the Ryan Construction Company., of Indianapolis, Ind.

BOISE, IDA.—Articles of incorporation of the Pend d'Orielle Electric Company, of Spokane, have been filed with the secretary of state. It is the intention of the company to install an electrical power plant at Sandpoint, this State.

LEWISTON, IDA.—It is reliably stated that should funds not be forthcoming from other sources, the Commercial Trust Company, through W. P. Hurlbut & Co., of New York, is prepared to construct the Lewiston & Southeastern Electric Railroad. The Commercial Trust Company is already promoting an immense irrigation project in the region which will be traversed by the proposed line.

WEISER, IDA.—Plans are being perfected for putting in an electric power-house at Ox Bow on the Snake River, for developing 8,000 horse-power to be transmitted to Caldwell, Idaho, and Baker City, Ore., and all intermediate points. It is estimated that over 30,000 acres of land along the Snake River will be watered by pumps driven by the electric power generated. Ten large tunnels will be run, but only one at first, which will be eight feet high and 20 feet wide.

HILLSBORO, ILL.—The Hillsboro Electric Light and Power Company has increased its capital stock from $25,000 to $50,000.

ISHER, ILL.—A franchise has been granted to the Wardlow Electric Lighting Company of this village to carry on and maintain an electric light plant here.

BREESE, ILL.—The Breese Water & Light Company is preparing to install a central lighting plant, and will receive bids on the entire equipment until Oct. 9. Wm. H. Bryan, St. Louis, Mo., is the engineer.

COLLINSVILLE, ILL.—Charles E. Slocum, of Belleville, has organized the Collinsville Gas, Electric and Refrigerator Company, which has been incorporated at Springfield, Ill., with $50,000 capital stock. The incorporators are Charles E. Slocum, John H. Seigel and W. E. Hadley.

CRAWFORDSVILLE, IND.—The contract for repairing the municipal electric light plant has been awarded to J. F. Davies, of Toledo, O., for $7,438. The work is to be done under the supervision of an engineer and is to include the installation of two new boilers of 250 horse-power each, making the pipe connections, the erection of two smoke stacks and various changes about the boiler room and plant.

MONTICELLO, IND.—A big undertaking near this city is suspended because the dam of the Tippecanoe Hydraulic Company, which was to have been finished Oct. 1, will not be completed until next year. The company has ceased building operations and will do nothing more this year. The plant is to cost $1,000,000 when it is finished. It is understood that the company is desirous of purchasing all the land likely to be flooded by backwater.

AFTON, IA.—The Council is considering the question of constructing a municipal electric light plant, or of granting a franchise for the plant.

HOPKINSVILLE, KY.—John H. Bell, Jr., of Hopkinsville, has secured a franchise for the construction and operation of an electric railway and electric light plant.

BOWLING GREEN, KY.—The County Commissioners are considering the best means of heating and lighting the county buildings, and it is quite probable that plans already in hand for a new power plant will be given to the contractor and the court house and jail heated and lighted from their own power department.

EASTPORT, ME.—The service furnished by the Eastport Electric Light Company has been considerably improved. It is the purpose of the company to make such immediate additions and improvements to the works that satisfactory service will be given in the future. An option is held on the water front property at the old Iron Works dam in Pembroke, now owned by the Sprague estate, and there is in contemplation the establishment of a power house at that place for generating the electric current to be used in Eastport. In the meantime Mr. C. E. Capen, a former owner of the electric light property here, is active in a purpose to build a new electric light plant in this city. He is negotiating with the Dennysville Lumber Company for a water power privilege at that place, by which a night and day service can be furnished in Eastport.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has been awarded the contract to wire the new central fire station.

AMESBURY, MASS.—George E. Gale, of Boston, has been at work buying up the stock of the Amesbury Electric Light Company. It is said he is trying to get control, with an idea of reorganizing the business.

FOXBORO, MASS.—The committee on the expenditure of the appropriation of $100,000 made by the last legislature for the construction of a central heating, lighting and power plant and additional buildings at the State hospital here, has practically decided upon plans and specifications for the enlargement of the institution. Work will be begun immediately after the awarding of the contract.

TAUNTON, MASS.—The Taunton Knitting Company's new mill on Ingell street will be run by power furnished by five motors. A new 25-horse-power motor is also to be placed in the White Warner plant on Tremont street to be used by the Huber-Hodgman Press Company, to be run by special power provided by the city, although there will be several other motors run by the company's own engines.

L'ANSE, MICH.—Plans have been completed for the construction of a municipal electric light plant.

SAGINAW, MICH.—The Rifle River Power Company, of Saginaw, has employed H. von Schon, Detroit, to examine and report on the development of Rifle River power.

MUSKEGON, MICH.—The Grand Rapids & Muskegon Water Power Electric Company has secured a franchise to erect poles and string wires through Muskegon Heights.

NASHVILLE, MICH.—The Thornapple Gas & Electric Company is preparing to make several improvements. Among other things will be the changing of the transformer station here to the south side of the river and the installation of an extra transformer for use in case of accident.

MASS CITY, MICH.—Arrangements have been made with the Mass Consolidated Mining Company to supply the village with lights. The company operates for its own use a dynamo with a capacity for 2,000 lights, but is using only 500. A new Corliss engine will be installed to operate the dynamo.

LANSING, MICH.—The Piatt Power & Heat Company has secured flowage rights on Grand River and will build a large dam six miles below Grand Ledge, which, with what it now holds, will develop 10,000 horse power. The company will erect a steam plant at Lansing to protect its customers against low water or floods.

SEBEWA, MICH.—Messrs. Mudge and Ewing, of Grand Ledge, have secured from several land owners options on land along Grand River, the land to be used for overflow for a site for a dam and power house. They have secured the options for Eastern capitalists. It is intended to build a 22-foot dam across the river near Sebewa and generate power for an electric railway.

STURGEON, MO.—Sturgeon's new municipal electric light plant was formally opened Sept. 15.

ST. LOUIS, MO.—Sharp rivalry has recently developed between the Laclede Power Company and the Union Electric Light & Power Company. Price cutting has been resorted to and it is seemingly apparent that each concern is making sharp concessions where it has been necessary to keep the rival company from securing new business.

MEREDITH, N. H.—The directors of the newly organized Meredith Electric Light Company have decided to increase the capital stock of the company from $9,000 to $16,000, and to change the system to an alternating one. The power house here will be done away with and power will be brought from Laconia.

BROAD ALBIN, N. Y.—The Broad Albin Electric Light & Power Company has been incorporated with a capital of $50,000. The directors are: W. P. Judson, H. C. Finch and Anna L. Judson, Broad Albin.

SOUTH GLENS FALLS, N. Y.—The Board of Village Trustees has awarded the United Gas, Electric Light & Fuel Company the contract to light the village streets for 5 years with 2,000-cp. arc lights, at $50 per light per year.

ROCHESTER, N. Y.—A certificate of incorporation of the Clyde Gas & Electric Company has been filed at the office of the county clerk. The company is to replace the old company of the same name and is capitalized at $25,000. There are three directors elected for the first year: Thomas W. Summers, of Ithaca; George S. Sheppard and William T. Morris, of Penn Yan.

AUBURN, N. Y.—At a hearing of the State Commission of Gas and Electricity the Citizens' Light and Power Company of Auburn asked to be allowed to increase its capital stock $175,000 and the Auburn Gaslight Company petitioned to issue bonds for $600,000 and to increase its capital stock $250,000 in order to absorb the property of the Citizens' company. Mayor T. M. Osborne, of Auburn, opposed the application of the Auburn company.

LOUISBURG, N. C.—The question of constructing a municipal electric light plant is under consideration here.

CANTON, OHIO.—The Best Light Company, capital $25,000, has been incorporated by C. V. Best, J. G. Best, H. G. Best, C. C. Best, R. G. Best and B. W. Best.

SALEM, OHIO.—E. E. Beam, of Cleveland, and S. D. Gilbert, of Cincinnati, have purchased the plant of the Salem Light & Power Co. and will rebuild and enlarge the plant.

PAWHUSKA, OKLA.—The Pawhuska Electric Light, Ice & Water Company has been incorporated with a capital of $25,000, by J. W. McCloud, of Little Rock, Ark.; W. C. Tucker, of Pawhuska, and others.

CHILLICOTHE, OHIO.—Five stockholders in the Chillicothe Electric Light & Power Company have sold their stock to G. A. Vaughters, president of the Citizens' Bank. This gives Mr. Vaughters control and there will be a change of management.

LAKEWOOD, OHIO.—Bids will be received until Oct. 3 by the Board of Trustees of Public Affairs for furnishing materials and building a brick addition to the electric light station and for installing complete, ready for piping, one new boiler at the Lakewood electric light plant.

LOUDONVILLE, OHIO.—The electric light plant was damaged by fire to the extent of about $3,000, Sept. 17. The fire is supposed to have originated in a pile of waste in the engine room. It is thought that it will require at least a month's time to put the machinery of the plant in running order.

TOLEDO, OHIO.—Mr. F. W. C. Bailey has filed a report to the effect that under very favorable conditions a municipal plant might be able to furnish arc lights to the city at $58 per year for 1,500 lights. Apparently this does not include, among other things, the taxes lost by the city on private enterprise doing the same work.

ALBION, PA.—Albion Council is considering the question of installing an electric light plant and water works.

WERNERSVILLE, PA.—The Wernersville Electric Light Company will soon start on its plant. It will be installed by Mr. C. S. Bomberber, Swatara Station, Pa.

GREENCASTLE, PA.—The Greencastle Light, Heat & Power Company has been incorporated with a capital of $10,000. Harry C. Hollinger, of Philadelphia, is treasurer.

READING, PA.—The ordinance granting a franchise to the Reading Illuminating Company has been defeated. Its aim was to introduce electric light competition in the city.

LANCASTER, PA.—The directors of the Edison Electric Illuminating Company and the Lancaster Gas Light & Fuel Company have awarded to the Providence Engine Company, of Providence, R. I., the contract for enlarging the electric light plant at Engleside for $165,000.

HUNTINGDON, PA.—The Juniata Water & Power Company has been incorporated, with offices at Huntingdon and Philadelphia. The company has purchased property for the erection of a hydro-electric power plant in Warrior Ridge Gap. The cost of the proposed plant will be about $1,000,000 and power will be transmitted to Huntingdon, Tyrone, Altoona and other towns in this vicinity. S. L. Brumbaugh, Philadelphia, is president.

BAMBERG, S. C.—This city will receive applications for a franchise for the construction of water works and an electric light plant.

BAMBERG, S. C.—An election will probably soon be held to vote on issuing bonds for an electric light plant and water works at a probable cost of $25,000. G. Moye Dickinson is the mayor.

BELTON, S. C.—The Belton Power Company has completed a big dam on Saluda River where electrical energy will be developed for running the Belton Cotton Mills, for street lighting in the town and for other purposes. The company has a capitalization of $300,000.

PIERRE, S. D.—The City Council has decided to install an incandescent electric light plant.

HURON, S. D.—The municipal electric light plant at Huron has run behind financially every year for six years. A deficit of $3,000 now exists.

CHATTANOOGA, TENN.—The plans for the lock and dam and the power plant of the Chattanooga & Tennessee River Power Company, to be constructed at Hales bar, in the Tennessee River, at a cost of about $3,000,000, are now ready for the inspection of contractors at the office of the U. S. Engineer here. Bids will probably be called for at once. John Bogart, of New York, is consulting engineer.

FORT WORTH, TEX.—A charter has been issued to the Consumers' Light & Heating Company; capital stock, $100,000.

BAY CITY, TEX.—The plant and property of the Bay City Ice, Light & Power Company is to be sold to the highest bidder by order of court. The plant cost about $40,000.

AUSTIN, TEX.—George B. Evans, representing Stone & Webster, of Boston, Mass., is here investigating the situation with reference to rebuilding the dam across the Colorado River. He says that if the project of utilizing the water power for generating electrical energy is deemed feasible and practicable Stone & Webster will take hold of the enterprise. The city stands ready to lease or sell the dam, part of which is standing. It is said to be the purpose of Stone & Webster, should Mr. Evans' report be favorable, to restore the dam and establish a large electric power plant here which is to form the basis for a new system of street railway, as well as one or two interurban lines out of Austin.

PROVO, UTAH.—It is proposed to construct an electric light plant and water works at a cost of $91,000. Frank C. Kelsey, Salt Lake City, is the engineer.

SALT LAKE CITY, UTAH.—The Telluride Power Company is contemplating the early construction of a power plant on Battle Creek, near this city. It will have a capacity of 25,000 horse-power.

OGDEN, UTAH.—A company will shortly be organized by Utah capitalists for the construction of a power plant at a point on the Blackfoot River, near Blackfoot, Ida. It is the design to supply Idaho Falls and Blackfoot and the intervening towns with electrical energy. The cost of the proposed plant is estimated at $100,000. E. W. Wade, of this city, is promotor of the enterprise.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Inter-Mountain Power Company will shortly be filed in this city. The company will have a capitalization of $1,500,000, and the chief stockholders will be Ohio capitalists who are at present represented here by J. J. Chambers of the Buckeye State. It is the intention of the company to establish four separate power plants, which will furnish a vast amount of electrical energy for mining and smelting purposes. Reservoir and power sites have already been acquired, and one of the company's first plants will be established in Cottonwood Canyon. Frank C. Kelsey of this city is the company's chief engineer.

BURLINGTON, VT.—The Plummer Electric Company, of Boston, Mass., has secured the contract for the conduit and wiring system for the U. S. Post Office for $1,813.

MANCHESTER, VT.—The manufacturing plant of the Vail Light & Power Company, at Manchester Depot, operated by the Hadley Manufacturing Company, was destroyed by fire a few days ago. The loss is estimated at $35,000.

CASHMERE, WASH.—F. C. Barnum, of Cashmere, is endeavoring to obtain a franchise to erect an electric light plant here.

CHINOOK, WASH.—The Chinook Light, Power & Water Company has been incorporated, with a capial of $10,000, by Albion L. Gile and others.

SEATTLE, WASH.—The city officials are considering the installation of another unit at the municipal electric light plant, at a probable cost of $15,000.

SPOKANE, WASH.—The Spokane-Palouse Light & Power Company has been incorporated with a capital of $100,000 by W. E. Goodspeed, B. H. Kiser, and others.

PORT TOWNSEND, WASH.—The City Council has received an application from W. A. Pfeiffer for a franchise to construct and maintain an electric light and power plant in connection with a gas plant.

TACOMA, WASH.—The Westinghouse Electric & Manufacturing Company is preparing plans, specifications and estimates for a municipal steam-power electric-generating plant, to be established within the city limits of Tacoma, with a maximum capacity of 12,000 horse-power.

PORT WASHINGTON, WIS.—The citizens have voted to issue $75,000 electric light and water works bonds.

MILWAUKEE, WIS.—The Finance Committee of Council on Sept. 13 adopted a resolution providing that $60,000 be set aside from the water fund to purchase a site for the municipal lighting plant.

VANCOUVER, B. C.—The estimated cost of constructing a municipal plant has been placed at $500,000.

METEPEC, MEX.—The City Council of Metepec has taken preliminary steps looking to the installation of an electric light and power plant for the city.

CHINIPAS, MEX.—E. T. Hovelman, of Chinipas, will establish an electric power plant on the Chinipas River for the purpose of operating mining machinery and reduction works.

TEXMELUCAN, MEX.—The Mexican Government has granted a concession to Andres Matienzo to establish an electric power plant on the Atoyac River, near the town of Texmelucan. The power will be transmitted to a number of towns in this region.

GUADALAJARA, MEX.—It is reported that the electric light and power plant of the Compania Industrial de Guadalajara is about to be sold to Canadian capitalists, who are largely interested in the Mexican Light & Power Company, of the City of Mexico.

SAN DIMAS, MEX.—Colonel Daniel M. Burns, of San Francisco, owner of the Candelaria mines, will erect a large hydro-electric plant for the purpose of supplying electric power for the operation of his mines and other mines and reduction plants in the San Dimas district.

MAZATLAN, MEX.—The Guadalupe de los Reyes Mining Company will install an electric power plant on the Piaxtla River at Los Barras, near this city. The electric power will be used to operate the machinery in the mines. The proposed plant will cost about $100,000.

XICOTLACOTLA, MEX.—Andres Lefebre is having the surveys made for a large electric power plant which he will establish at Xicotlacotla. Transmission lines will be built to towns of Guerrero and the state of Morelos, and the electric power used for operating industries and furnishing lights.

ZACATECAS, MEX.—The Compania del Alumbrado Electrico del Comerico de Zacatecas has been organized for the purpose of constructing and operating a large electric light and power plant in the city of Zacatecas. The company has a capital stock of $100,000, and is composed of local business men.

MICOS, MEX.—A company has been organized for the purpose of establishing a large electric power plant at Micos. The proposed plant will be located at the water falls, where it is estimated that not less than 10,000 horse-power can be generated. It is proposed to build transmission lines from the main generating plant to the cities of San Luis Potosi, 75 miles distant, and Tampico, about 150 miles distant.

TORONTO, ONT.—The Georgian Bay Power Company, of Toronto, has engaged H. von Schon, Detroit, Mich., to plan the development of Eugenia Falls on Beaver River, Ont., where a head of about 400 ft. will be available.

KINGSTON, ONT.—The city of Kingston, Ont., has conducted its electric and gas plants as a municipal utility for a year, and has a surplus of $15,000 after spending some $6,000 on needed repairs. The works are to be much extended and improved, when it is expected cheaper light can be provided at a good profit.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company announces that an electric car line will be built to Boyles, four miles from the city. The estimated cost of the line will be about $40,000, and will be constructed in the nature of an extension of the Gate City line.

WOODLAND, CAL.—The Board of Supervisors at Woodland has granted J. Reith, Jr., a franchise to build electric railway lines along the country roads of Yolo County. W. F. Forsman, a rival promoter of railways, objected, through his attorney, to the granting of the franchise on the ground that it would conflict with a franchise granted to N. A. Hawkins. A damage suit will be filed. The Northern Electric Company, which has closed a contract with the Westinghouse Electric & Manufacturing Company for three 400-kw. motor-generator sets for its sub-stations on its new electric railway connecting Chico and Oroville, Cal., is in the market for three 55-ft. electric cars of standard passenger type, which are to be run 60 m.p.h. Four 50-hp. motors will be placed on each car. Sub-station No. 1 will be located at Chico, No. 2 at Durham, 9 miles south, and No. 3 at a point 5 miles northwest of Oroville. There will be three 150-kw. step-down transformers and one spare transformer at each sub-station. This company has purchased the Chico Electric Railway and has placed Frank Ross in charge as manager of the local system. Mr. Ross was formerly with the California Gas & Electric Corporation at Sacramento.

NAUGATUCK, CONN.—It is understood here that the new company which has a charter for an electric railway from Waterbury to Woodbury, has completed its purchases of property for a private right of way for a considerable portion of the line where it leaves the highway.

NEW HAVEN, CONN.—President Mellen, of the New York, New Haven & Hartford Railroad Company, denies that that company has made an offer for a controlling interest in the Boston & Worcester Street Railway Company, and states that the company will buy no more electric railways at present.

ROCKFORD, ILL.—The Rockford, Beloit and Janesville electric railway, connecting this city and Janesville, has been sold to a party of Cleveland capitalists.

EVANSVILLE, IND.—The directors of the Evansville & Princeton Traction Company have elected the following-named officers: President, Joseph Heston; vice-president, J. G. Lagrange; secretary, H. C. Redman; general manager, W. P. Larcey.

WABASH, IND.—The Indiana Northern Traction Company has financed the interurban line connecting Wabash and Warsaw. The Indiana Central Traction Company has filed a mortgage for $800,000 to protect a bond issue for a line between the same cities.

EVANSVILLE, IND.—Articles of incorporation have been filed by the Indianapolis, Vincennes & Evansville Electric Railway Company, with home office in this city. It is proposed to connect Evansville, Vincennes and Indianapolis and intervening towns.

INDIANAPOLIS, IND.—The Randall Morgan interests are combining under one management the Indianapolis & Eastern, the Richmond Street & Interurban and the Martinsville and the Indianapolis & Plainfield companies, with headquarters in the Terminal Station.

SOUTH McALESTER, I. T.—The Washita Valley Interurban Electric Company, of Tishomingo, has been incorporated with a capital of $12,000,000 by W. T. Croslan, J. G. V. Redmon and M. R. Morris. The company will build an electric interurban railway from Shreveport, La., through Texas, Indian Territory and Oklahoma to Anadarko, O. T., together with branch lines in these states and territories.

HOPKINSVILLE, KY.—The 20-year franchise for an electric street railway system and electric light plant offered for sale some days ago was purchased by John H. Bell, Jr., of Hopkinsville.

LEXINGTON, KY.—Official announcement is made that negotiations have been closed by which the owners of the Lexingon Street Railway Company system, including the gas, the electric light plant, two ice factories and the street car system, is acquired by a syndicate of Philadelphians, at the head of which are J. Levering Jones and Chandler Brothers. In addition to the public utility companies of Lexington, the syndicate has purchased the Blue Grass Traction Company, owning the interurban lines from Lexington to Paris and to Georgetown, the Central Kentucky Traction Company, owning the interurban lines from Lexington to Versailles, and the Frankfort Power & Light Company. The amount involved in the purchase of the properties is $8,000,000.

WARE, MASS.—The auction sale of the property of the Hampshire & Worcester Street Railway by the receiver has been postponed from Sept. 16 to Sept. 30.

TREMONT, MASS.—The statement is given out that the incorporators of the proposed electric railway from Wareham to Plymouth, the Plymouth, Carver & Wareham Street Railway Company, have secured sufficient money to assure the building of the road, and work upon construction will be begun as soon as practicable.

DULUTH, MINN.—The first long-distance electric railway out of Minneapolis promises to be built northward to this city. C. C. Cokefair, of the Great Northern Power Company, is interested.

ST. LOUIS, MO.—The St. Louis, Vandalia, Terre Haute & Eastern Traction Company has been formed with a capital of $1,000,000, by Lewis H. Bissell, Effingham, Ill., and George D. Steinhauser, Vandalia, Ill.

CAMDEN, N. J.—The Camden, Gloucester & Woodbury Railway Company has accepted ordinances of townships along its proposed route.

HOBOKEN, N. J.—The Jucaro and San Fernando Railroad and Transportation Company has been formed here with a capital of $500,000. Incorporators: George G. Schreiber, George W. Ireland, J. W. Rufus Besson, Francis A. Stevens and Leonidas H. Besson.

ALBANY, N. Y.—The Manhattan & Long Island Railroad Company, of New York City, has been incorporated with a capital of $10,000,000, to operate an electric railway 80 miles long in Greater New York and on Long Island. The road is to run from Long Island City to Northport. The directors are: Edward Mackey, D. T. Meyer, H. H. Bowtell, Samuel Y. Sauber, Franklin M. Walter and George E. Macardle, of New York City; Robert M. Stockwell, of Yonkers; A. Paroutaud, of Brooklyn, and Henry Guinard, of Watchung, N. J.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company will build an addition to the brick power house on Washington Street and Cuyahoga River, to cost $25,000.

ALLIANCE, OHIO.—The Alliance, Akron & Cleveland Railway Company has organized with High Bleakley, president; G. L. King, vice-president; R. S. Kayler, secretary-treasurer.

STEUBENVILLE, OHIO.—The Steubenville & Wellsburg Traction Company has been incorporated with $10,000 capital stock by J. Dunbar, M. Keane, D. J. Sinclair, Robert McGowan and others.

SANDUSKY, OHIO.—The Sandusky, Fremont & Tiffin Traction Company has been incorporated with $100,000 capital stock by Charles Thompson, W. H. Gilcher, John G. Dorn, D. B. Sharp and others.

WAPAKONETA, OHIO.—A special meeting of stockholders of the Sandusky Southwestern Railway Company will be held Oct. 2 to vote on an increase of the capitalization from $1,000,000 to $2,000,000. The road is in the hands of a receiver and the court has been petitioned to allow the increase.

HAMILTON, OHIO.—At the annual meeting of the Cincinnati, Dayton & Toledo Traction Company the following officers were elected: President, George B. Cox; vice-president, C. C. Richardson; second vice-president, J. B. Foraker, Jr.; secretary-treasurer, F. R. Williams; general counsel, W. C. Shepard.

DAYTON, OHIO.—The project known as the Cincinnati, Dayton & Fort Wayne Railway, which was promoted by Dr. Samuel F. George, of Dayton, three years ago, is being revived. A meeting will be held at Fort Wayne this month. It is stated that New York capitalists have been interested.

CLEVELAND, OHIO.—The Cleveland, Berea & Southern Railway Company has been incorporated, with $10,000 capital stock, by C. C. Downs, W. S. Mitchell, W. G. Benedict, Frank Cowdry, and others. The company expects to build from South Brooklyn, the terminus of the Pearl Street line of the Cleveland Electric Railway, to Berea, 12 miles.

HARRISBURG, PA.—At last week's meeting the directors of the Central Pennsylvania Traction Company decided to install reciprocating engines and direct-current equipment in the new $250,000 power house to be built on the site of the present main power plant on South Cameron Street.

EPHRATA, PA.—There is a movement on foot among the people of the northern section of Salisbury township, to build a trolley line from the New Holland line at Groffsdale to White Horse. Estimates place the cost at $150,000.

PITTSBURG, PA.—Private right of way has practically been secured for the Shenango Street Railway Company. This line will be 65 miles long and will connect New Castle, Sharon and other Shenango Valley points with Conneaut Lake, Meadville and Cambridge Springs and will form the connecting link between Pittsburg and Erie, a distance of 150 miles.

POTTSVILLE, PA.—The Council of Frackville has granted to the Tamaqua & Pottsville Electric Railway, one of the allied interests of the Pottsville Union Traction Company, a franchise through the town. A new branch between Pottsville and Shenandoah, fourteen miles long, is about to be started. This, with an eight-mile road to be built from Middleport to Tamauqua, will be the connecting link to afford electric railway travel from Pottsville to Scranton.

IRWIN, PA.—Application for a charter will be made for the Greensburg and Sewickley Street Railway Company. The road will tap an entirely new country, extending from the new Stanton road in Hemphill Township to the coal towns of Arona, Madison and Herminie. It will be mainly over private right of way and at various points will connect with existing and contemplated lines. Congressman George F. Huff, his son, Colonel Lloyd Hull, Richard Coulter and H. F. Bovard are among those interested.

STROUDSBURG, PA.—The Stroudsburg & Wind Gap Trolley Company has been reorganized. The company was originally organized May 4, 1903, and the charter provides for the building of an electric railroad from Stroudsburg to Wind Gap, via Kellersville, Sciota and Saylorsburg. Consent was obtained from all municipalities between the two towns prior to May 4, 1905, for the use of streets. The following are the new officers: President, J. B. Williams; vice-president, Joseph Shiffer; treasurer, G. A. Schneebeli; secretary, E. P. Arbogast.

PITTSBURG, PA.—Charters have been granted in Harrisburg to three street railway companies to construct lines which will connect Ambridge, Baden, Economy and Freedom, and which will be a portion of the long-distance trolley line to be constructed between Pittsburg and Beaver for which surveys have already been made. The companies are the Freedom & Baden Street Railway Company, capitalized at $6,000; president, John H. Park, Beaver. The Economy & Harmony Street Railway Company, capital, $16,000; president, William A. Park, Rochester. The Ambridge & Baden Street Railway Company, capital stock, $12,000; president, W. E. Guy, Pittsburg.

SAN ANTONIO, TEX.—A movement is on foot in Campbellton to build an electric railway to run in this city. For further information address W. A. McCoy, of Campbellton.

FORT WORTH, TEX.—The Fort Worth & Mineral Wells Electric Railway Company has been chartered, with a capital stock of $250,000. Its principal office is at Fort Worth. The board of directors is composed of Cicero Smith, D. M. Howard, H. N. Frost, E. J. Waldron and Albert Stevenson, all of Mineral Wells.

Obituary.

DR. L. H. LAUDY.—We note with great regret the death of Dr. Louis H. Laudy, late professor of chemistry in Columbia University, New York. The cause of death was apoplexy. Mr. Laudy's father, a man of great wealth and political prominence in the French Republic and who had represented his government as Minister at Madrid, came to this country and settled in Gouverneur, N. Y., where his son, Louis, was born. Dr. Laudy was a member of the Alumni of Cooper Union, a fellow of the New York Academy of Science, and of the Association for the Advancement of Science, member of the New York Electrical Society, life member of the American Institute and vice-president of the Henry Electric Club. For a long period he was secretary of the American Institute and was president of its polytechnic section. He was in his sixty-third year. He leaves no children. Dr. Laudy took a deep interest in electrical development and had a wide circle of electrical friends.

MR. E. B. CARSON.—A special dispatch from Newport, R. I., of September 21 says: "Word has been received here of the death in New Orleans of yellow fever of Edward B. Carson, of this city, an electrician in the Westinghouse Company's employ. Although a young man, he had a notable career in the United States Army. In January, 1898, although but 16 years old, he enlisted in the United States Army as a trumpeter, and in April was sent to Washington, where he joined a light battery and went with it to Tampa, Fla., and later participated in the campaign before Santiago. There he performed deeds of bravery which brought him personal thanks from President McKinley. He was next transferred to the Signal Corps, and assigned to the School of Instruction at Fort Meyer, Va., from which he was sent to Manila, remaining in that vicinity until the expiration of his enlistment. While on duty with a party in Manila Carson received a Filipino bullet in the arm. For rescuing a detachment of soldiers in Southern Luzon he received a medal of honor and an appointment as an electrician sergeant."

Personal.

MR. JAMES R. THOMPSON.

MR. JAMES R. THOMPSON, a young man who has made a conspicuous success as chief electrical engineer of the Lewis and Clark Exposition, at Portland, Ore., is a native Portlander. He was born in that city Feb. 11, 1871. He received his education in the grammar schools, and served three years in a broker's office before entering the electrical business. From 1891 to 1892 he was in the employ of the Willamette Falls Electric Company. The following year he attended Stanford University, and then returned to electrical work in the employ of the Portland General Electric Company, which had become the successor of the Willamette Falls Company. He remained with this company until 1904, serving in various capacities, and left the service of the company to become electrical engineer for the exposition in 1904. He designed and superintended the construction of all the electrical illuminations at the fair. Personally he is a quiet, modest man, easily approachable, well liked by all those who serve under his directions, and is not in the least spoiled by the enviable success he has so early attained. The details of the electrical work and illuminations have already been given in these pages.

PROF. A. H. FORD has been elected to the chair of electrical engineering at the University of Iowa, Iowa City.

MR. C. A. TERRY, secretary of the Westinghouse Electric & Manufacturing Company, has just returned to New York from a European trip.

MR. CARL B. AUEL, assistant general manager of the Trafford Park Works of the British Westinghouse Company, has arrived in the United States for a short visit.

DIRECTOR F. A. SPIECKER, of the Siemens & Halske Company, of Berlin, accompanied by Dr. O. Feuerlein, manager of the incandescent lamp department of the same organization, is due to arrive in New York City from Europe about October 1.

MR. R. S. HALE, of Boston, has been appointed general agent of the Edison Company of that city, in charge of the commercial department. He has resigned his position as engineer of the Mutual Boiler Insurance Company, and will devote his entire energies to the new work.

MR. D. W. ROPER has been appointed assistant chief operating engineer of the Chicago Edison Company, succeeding Mr. W. G. Carlton, who has resigned to become superintendent of power for the New York Central Railroad Terminal in New York. Mr. Roper, who was formerly electrical engineer of the Missouri Edison Company, at St. Louis, has been on the engineering staff of the Chicago Edison Company for about two years.

DR. WYSSLING, professor of electrical engineering in the Polytechnic Institute at Zurich, Switzerland, and Charles Wirth, also of Zurich, inspected the line of the Indiana Union Traction Company, and the company's powerhouse in Anderson, Ind., during the past week. Dr. Wyssling and Prof. Wirth are members of a commission appointed to make a report to their home government on electric railway development in America.

MR. GEORGE P. LOW, of San Francisco, has severed his relations with the *Journal of Electricity, Power and Gas*, and is now engaged in the specialization of engineering work, from its literary side more particularly. Mr. Low has for some years done a great deal of work in the field of technical literature, and will now be free to devote his energies to the description of engineering installations and properties, the prospectuses of new industries, etc.

PROF. L. I. BLAKE.—Prof. L. I. Blake, head of the department of electrical engineering at the University of Kansas, has been granted a year's leave of absence. He has been appointed chief engineer of the new submarine signal company, which handles his invention for telephoning between ships, using the water as a medium. The system is already being used on American warships, and has recently been adopted, it is said, by the German government.

MR. J. F. WITMER.—J. G. White & Co., of New York, have secured the services of Mr. J. F. Witmer, B. A., C. E., of Buffalo, N. Y., who will assume charge of special work bearing on hydraulic engineering in foreign fields. Mr. Witmer is a specialist of many years standing with offices at Buffalo, N. Y., and during the last ten years has designed and superintended the construction of water works systems at upwards of 30 different towns and cities in the United States.

MR. A. W. LEONARD, manager of the Houghton, Mich., lighting and trolley interests, denies the report that he has been appointed manager of the General Electric Company of Minneapolis. He says that the rumor may be due to the fact that he was recently in Minneapolis for about three weeks on special work connected with the development of Taylor's Falls water power. The manager, for many years past, of the Minneapolis company is Mr. A. M. Robertson.

MR. GEORGE A. DAMON, managing engineer of the Arnold Company, Chicago, has been awarded the Chanute medal for 1904 by the Western Society of Engineers for the best paper on an electrical engineering subject presented to the Society during that year. This paper, which was on the subject: "The Opportunities in the Electrical Business," created wide-spread comment at the time it was presented and resulted in the most crowded house the Society ever had on the evening it was discussed.

MR. FRANK HOOKER ALFRED has been appointed general manager of the Canadian J. G. White Company, Ltd. Mr. Alfred was born December 24, 1866, and educated at the University of Michigan and the Ohio State University. From 1887 to 1890 he was engaged successively as rodman, transitman and resident engineer on railroad construction. From 1890 to 1894 was with the Norfolk & Western Railroad, during which time he had charge of the field work on the construction of their terminals at Columbus, Ohio. From 1894 to 1896 was with the engineering department of the Hocking Valley Railroad. From 1896 to 1899 was engineer of maintenance of way of the Cleveland, Akron & Columbus Railway, and from 1899 to 1900 held the same position with the Wheeling & Lake Erie Railway. From 1900 to 1902 was division engineer of the Pere Marquette Railway, and from 1902 to the present time chief engineer of the same road. During this period the railroad was reorganized and extended into Chicago and Buffalo, involving the construction of new lines and terminals. New shop buildings and yards at Grand Rapids, Mich., and new shops at St. Thomas, Ontario, have just been completed under his supervision. Mr. Alfred is a member of the America Institute of Electrical Engineers.

MR. KENNETH B. THORNTON, of Montreal, has been appointed operating engineer of the Canadian J. G. White Company, Ltd. Mr. Thornton was born at Montreal, June 23, 1873, and was educated in London, England. After taking a three years' course in electrical and mechanical engineering at the Central Technical College, South Kensington, London, England, he returned to Canada in June, 1893, and entered the Royal Electric Company, Montreal, working in the several manufacturing departments and also in the testing and drafting departments. In September, 1895, he was transferred to the operating department of the Royal Electric Company, which at that time was supplying light and power in and around Montreal. From that time to August, 1905, Mr. Thornton has been intimately associated with the construction, operation and engineering details in connection with the generation and distribution of light and power for the Royal Electric Company, and latterly for the Montreal Light, Heat & Power Company, which company finally secured a monopoly of all the electric companies in Montreal in 1903. During this period the amount of power generated increased from about 7,000 hp in 1895 to over 30,000 hp in 1905. Mr. Thornton is a member of the American Institute of Electrical Engineers, the Canadian Society of Civil Engineers and past-president of the Canadian Electrical Association.

MR. F. S. DICKSON.—Mr. Frederick S. Dickson, president of a number of independent telephone companies in Ohio, has written a book on "Telephone Investments—And Others," which will be published about October 1. This volume deals with the various forms of investment now offered to the public in America, and compares them one by one with the telephone. He considers government bonds, real estate, bank and trust company stocks, industrials, mines and public service corporations. The latter are divided into those supplying water, power, light, heat, transportation and communication, and the latter subject considers mail, telegraph, and telephone. Mr. Dickson's experience in the telephone field and on the directorate of various manufacturing and transportation companies in Philadelphia qualifies him to speak with authority on his chosen subject. He is not unknown in the literary field, as his out-of-door book, "And the Wilderness Blossomed," was highly commended on its appearance a few years ago. He contribuated lately to the extensive bibliography to General Wilson's book on "Thackeray in the United States," so his last volume promises something of a literary as well as a business flavor. The volume is illustrated and with large type, good paper and bound in limp art linen, makes an attractive appearance. It is issued by the Publication Department of the Cuyahoga Telephone Company, Cleveland.

Trade Publications.

REFRIGERATING MACHINES.—A recent catalogue of the York Manufacturing Company, York, Pa., presents in an attractive manner the advantageous features of the vertical single-acting ice and refrigerating machines.

WATTMETERS.—The Gregory Electric Company, 54 Clinton St., Chicago, in addition to its regular monthly publication has issued a flyer calling attention to a special sale of wattmeters. Although these meters have been in use, the company states that they are in all respects equal to new.

TELEPHONES.—The Dean Electric Company, Elyria, O., has issued folders No. 4 and No. 8, dealing, respectively, with magneto local-battery telephones and common-battery switchboards. In folder 4 are shown numerous diagrams of telephone circuits for the various uses to which telephones may be put. Folder 8 shows front and rear views of the internal mechanism of common-battery switchboards and also illustrates the apparatus used in the switchboards.

WIRING SPECIALTIES.—Supply catalogue No. 7590 of the General Electric Company, Schenectady, N. Y., treats of fuses and enclosed fuse cut-outs which have been designed to conform to the requirements of the Underwriters according to the specifications for the National Electrical Code Standard. Price list No. 5140 of the same company, refers to braided and lead-covered varnished cambric insulated cables for working pressures of from 125 to 15,000 volts.

AIR BRAKES.—The National Electric Company, Milwaukee, Wis., has just issued bulletin No. 357, dealing with Christensen air-brake equipments. The Christensen system is described fully, the various mechanical details being illustrated. The air compressor is driven by electric motor, governed by the pressure of the air. These equipments have been designed especially for use with electric cars. It is stated that more than 15,000 are in successful use at the present time.

OIL ENGINES.—The De La Vergne Machine Company, foot of 138th Street, New York, has issued a neat 74-page catalogue dealing with Hornsby-Akroyd oil engines. These engines are well suited for operating isolated electric plants. A table is given to show that with a certain 125-hp. engine the total cost, including interest on investment and depreciation, at 12 per cent., per brake hp-year of 3,000 hours, was $25.37. It is stated that there are more than 10,000 of these engines now in operation.

DIRECT-CURRENT RAILWAY MOTOR.—The Westinghouse Electric & Manufacturing Company, Pittsburg, has just issued circular No. 1120, describing what is stated to be a motor of the largest capacity which has yet been used on cars for passenger service. This is the Westinghouse No. 113 railway motor, which is rated at 200 horse-power. The general constructional features and the operating characteristics are fully discussed. A description of this motor appeared on page 536 of our issue for Sept. 23.

BELT-DRIVEN DIRECT-CURRENT GENERATORS.—Bulletin No. 355 of the National Electric Company, Milwaukee, Wis., is devoted to type M. B. generators. The pole pieces of these machines are made of steel castings, circular in cross section, and are bolted to the frame. The pole shoes are built up of laminated sheet steel, and are bolted to the pole pieces. These shoes aid in a better distribution of the magnetic flux in the air gap, secure sparkless commutation under widely varying loads, and in addition serve to hold the field coils in place.

LIGHTING SPECIALTIES.—The General Electric Company, Schenectady, N. Y., has recently issued several diminutive bulletins called "Fliers" dealing with lighting supplies. No. 2163 treats of standard key and keyless sockets, No. 2164 describes concentric diffusers for incandescent lamps, while No. 2165 is devoted to sockets of the key and keyless types for electroliers; 3329 tells of the advantageous features of the G. E. incandescent lamps, and 3361 serves to show why the electric cigar lighter, which might now be considered a luxury, will soon become a necessity.

FLEXIBLE METALLIC CONDUIT.—The Sprague Electric Company, 527 West 34th Street, New York, has just issued a handsome illustrated bulletin, designated as No. 422, which serves to show that its flexible metallic conduit and flexible steel-armored conductors are used successfully in finished buildings, and in new structures under construction, for almost every class of electric wiring. The bulletin contains numerous illustrations of buildings in which its metallic conduit is used. These buildings represent every type of modern fireproof structure, as well as some of the best-known older buildings of the United States. Several views are given of some of the most modern and best-equipped steel ships, on which the flexible steel armored products are used.

STORAGE BATTERY FOR VOLTAGE REGULATION.—The Gould Storage Battery Company, Depew, N. Y., has issued a well-illustrated bulletin, designated as No. 6, which contains an article descriptive of the storage battery installation of the Edison Electric Illuminating Company, of Topeka, Kan. This installation consists of 280 elements, each having a capacity of 640 amperes for one hour, and a booster-set which controls the operation of the battery so that the generator load does not vary, even under extreme conditions, more than 2.5 per cent from any mean valve for which the booster may be adjusted. This battery was installed to equalize the load on the railway generators and to insure good voltage regulation on the various supply circuits.

PREPAYMENT WATT-HOUR METERS.—Circular No. 1123 of the Westinghouse Electric & Manufacturing Company deals with a new type of single-phase prepayment watt-hour meter for two-wire and three-wire circuits. This meter is built on the principle of an induction motor, with a light rotating secondary whose speed is determined by the value of the power being used upon the circuit to which it is connected, and is similar in general to the Westinghouse type B watt-hour meter, with the addition of the prepayment feature. The addition consists essentially of a circular dial and pointer, a coin slot and a circuit-closing mechanism. When a quarter is inserted in the slot, it strikes a wheel releasing a spring which closes the circuit through the electromagnet of a switch connected to the main circuit.

POLYPHASE INDUCTION MOTORS.—Bulletin No. 1068 of the Fort Wayne Electric Works, Fort Wayne, Ind., describes a line of polyphase induction motors recently placed upon the market. The lamination for the stator of the machine is held in a skeleton frame which gives maximum surface for cooling without sacrificing rigidity. For constant-speed work, the machine is provided with a squirrel-cage secondary winding and is started by means of a "compensator," which consists of two auto-transformers for a two-phase motor or three auto-transformers for a three-phase motor. For variable-speed work, or where a large starting torque is required, the secondary is coil-wound, and provided with extra resistance which may be placed external to the machine, or mounted directly on the shaft of the rotor. The several types of motors, indicated above are illustrated and described at length.

A HANDSOME SOUVENIR EDITION.—*The Street Railway Journal* has been making a practice of issuing souvenir numbers on the occasion of the annual conventions of the American Street Railway Association. This year's number surpasses all of its predecessors in every respect, and represents the highest development of the printer's art. Its design is artistic and harmonious throughout, and yet it is intensely utilitarian. It is replete with practical articles on street railway progress, the principal one being devoted to a complete description of the transportation facilities in and about Philadelphia, where this year's convention is held. The book contains 184 reading pages, over 200 pages of advertisements and about 60 pages devoted to a dictionary of electric railway material, supplies and apparatus. This dictionary gives definitions for practically everything used by an electric railway, and its publication is an entirely new departure in technical journalism. The cover design of the Convention Souvenir issue has for its central idea an artistic presentation of the Liberty Bell, with a conventional reproduction of Independence Hall and an old stage coach at the left, and the Philadelphia City Hall with a modern electric railway car at the right. The illustrations are of the highest order and very effectively arranged, and all together this number would seem to justify the belief of the publisher that it is the most elaborate edition of a technical periodical ever published.

News of the Trade.

MR. LOUIS G. SEDBERRY has been made superintendent of the Wetumpka, Ala., municipal light plant and water works. He desires to receive trade literature relative to the lines of work indicated.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, now located at 2017 Locust Street, St. Louis, has purchased a tract of about ten acres, adjoining the right of way of the Wabash Railroad near Page Avenue.

TOLEDO TRANSFORMERS.—The F. Bissell Company, Toledo, O., has been awarded the contract by the Toledo Gas, Electric & Heating Company for the transformers for the new plant. The transformers will aggregate 600 horse-power.

MR. V. C. GILPIN, who has a most extensive acquaintance among electrical people, has finished the special work in which he was engaged with the Perkins Electric Switch Manufacturing Company, and will open an office at 39 Cortlandt Street, New York City, for the representation of electrical manufacturers.

THE WILLARD STORAGE BATTERY COMPANY has been awarded the contract, through the Union Switch & Signal Company, for all of the storage batteries for the Lake Shore & Michigan Southern Railway signal system, comprising several thousand cells. The Willard Company has entirely recovered from the fire which recently destroyed its works, and is now turning out batteries in the usual quantities.

DULUTH AERIAL BRIDGE FERRY.—The Keelyn Electric Company, of Milwaukee, Wis., write us as follows: "We did the work at the Ferry for the Modern Steel Structure Company, of Waukesha, Wis., and our electrician was on the job six weeks. The writer laid out the work and ordered the material. We have informed several parties that we had furnished this equipment and propose to use this job in getting other work in this line."

MACHADO & ROLLER, of New York City, have just opened a branch office in the Monadnock Building, Chicago. It is in charge of Mr. H. I. Shire, formerly of their New York office, and will carry a large stock on hand of the standard Whitney instruments, so as to be able to make prompt deliveries to the local trade. A portion of the stock has already been made available in Chicago, where secondary standards will also be kept for comparison purposes. Repairs will also be made there. Machado & Roller were led to make this new departure by the rapidly increasing popularity of the instruments and other lines handled by them in that section of the country.

MADISON SQUARE GARDEN ELECTRICAL SHOW.—The managers of the Madison Square Garden Electrical Show report that they are meeting with very gratifying and substantial co-operation from the electrical industry. Since the announcement of the broad-gauge plans which have been developed for insuring a great popular success at the Garden next December, a great many new contracts for space have been received. Among others the following well-known firms have selected their space and are busy preparing attractive exhibits: National Carbon Co., Harry M. Stevens, Eastern Carbon Works, Joseph Goldfinger, New York Telephone Company, Chicago Pneumatic Tool Company, Electro-Dynamic Company, General Storage Battery Company, G. M. Gest, Ovington Manufacturing Company.

DOBLE LABORATORY WATER WHEELS.—The Abner Doble Co., of San Francisco, announces that the University of Michigan has purchased the tangential water wheel which it exhibited at the St. Louis World's Fair, and for which the company was awarded the grand prize. This wheel is to be installed in the hydraulic laboratory of the new Engineering Building at Ann Arbor, Mich., where it will be mounted in connection with a duplex pump for experimental purposes, its output being 100 hp when operating under a head of 580 feet. The 12-inch laboratory water motors which the Abner Doble

Co. builds for technical schols and universities have attracted considerable attention among the engineering faculties of the leading educational institutions, and the interest shown in these small water wheels has resulted in an increasing demand for them, orders having recently been received from the University of Wisconsin, the Michigan School of Mines and the University of Toronto.

THE PERU ELECTRIC MANUFACTURING COMPANY has opened an office in New York City, at 39 Cortlandt Street, in charge of Mr. Robert J. Mulligan, who is well known to the New York trade. Mr. Mulligan will be pleased to furnish prices, samples and literature to anyone interested in the line of switches, sockets, rosettes, etc., made by this company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 19, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

799,658. TELEPHONE SIGNAL APPARATUS; David Frame Laughlin, Clyde, Kan. App. filed June 13, 1905.

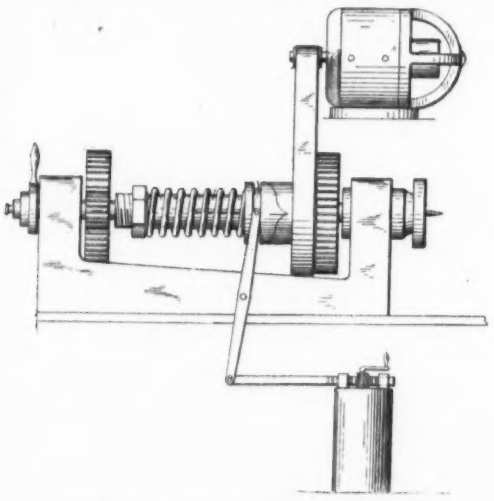
799,684. ELECTRIC FUSE; Henry N. Snyder and Lewis A. Hardison, Santa Paula, Cal. App. filed Aug. 8, 1904. A fuse wire is supported within a protecting tube by a zig-zag insulating strip having aligned holes for the wire. The zig-zag strip serves as a support, and prevents the formation of an arc.

799,704. ELECTRIC RAILWAY SIGNAL; Joseph Bartl, Chicago, Ill. App. filed Feb. 26, 1904. An alarm circuit designed to notify a train of the presence of another train on the same block, is completed by staggered rail sections along the track which make a circuit with trolleys on the trains when both lie between the insulated sections.

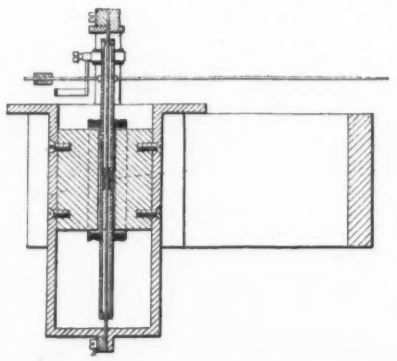
799,717. VARIABLE SPEED DRIVING MECHANISM; Howard A. Coombs, Washington, D. C. App. filed Jan. 30, 1905. In order to accord the motive power with the load requirements in a machine tool, the torque is effective to displace a cam which turns on more current at the motor controller.

799,720. ELECTROMAGNETIC CLUTCH; Henry H. Cutler, Milwaukee, Wis. App. filed Sept. 22, 1902. The clutch members are arranged with an intervening spring which exerts a yielding pressure to throw the members out of contact and insure the disengagement of the clutch regardless of residual magnetism. A special form of controller reverses a portion of the operating current through the clutch to further deenergize its residual magnetism.

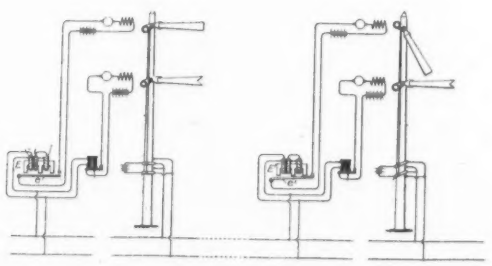
799,721. MULTIPLE SWITCH; Henry H. Cutler, Milwaukee, Wis. App. filed Mar. 24, 1905. A motor starter in which the component contactor switches can only be closed in a predetermined order, and all of which must be closed in order to be retained in closed relation. This is accomplished by making the retaining mechanism dependent upon the closure of the last switch in the series.



799,717.—Variable Speed Driving Mechanism.



799,733.—Means of Supporting Movable Elements of Electrical Instruments.



799,816.—Block Signal System.

799,722. PORTABLE SUPPORT FOR TELEPHONES; Augustus G. Davis, Baltimore, Md. App. filed Jan. 5, 1905.

799,726. INSULATOR; Ernest J. Foreman, Trinidad, Col. App. filed Mar. 16, 1905. A telephone insulator comprising a porcelain tubular shell with overhanging surfaces which act to shed water away from the interior parts.

799,733. MEANS OF SUPPORTING MOVABLE ELEMENTS OF ELECTRICAL INSTRUMENTS; Eugene Hartmann, Frankfort-on-the-Main, Germany. App. filed Jan. 3, 1903. The movable part has a central tube with a jewel eye at each end through which is stretched a wire constituting a stationary spindle. This wire is made one terminal of the armature circuit, the other terminal being formed by a tortion spring secured to the tube.

799,748. CONNECTING WIRE TO BINDING POSTS; William Mills, Elizabeth, N. J. App. filed Dec. 27, 1904. A terminal fixture for connecting wires composed of sheet metal stamped and drawn in a special way. A disk of rubber is clamped into the structure so as to exert a constant yielding pressure to make a good contact at the binding post. This prevents the connection being broken by vibration in gas engines, etc.

799,780. SELF-PROPELLED VEHICLE; Joseph Le Conte Davis, Schenectady, N. Y. App. filed April 9, 1904. (See Current News and Notes.)

799,790. ELECTROMAGNETIC LOCK FOR AUTOMATIC CIRCUIT BREAKERS; John D. Hilliard, Jr., Glens Falls, N. Y. App. filed Nov. 17, 1902. A circuit breaker arranged to operate only for the load for which it is designed. For this purpose a special quick acting locking magnet is located in series with the circuit breaking magnet, and locks the circuit breaker against action in case of an excessive overload.

799,798. LIQUID HEATER AND STRAINER; William J. Morrison, Nashville, Tenn. App. filed Nov. 7, 1904. (See page 570.)

799,807. BLOCK SIGNAL SYSTEM; Henry N. Sporberg, Schenectady, N. Y. App. filed Apr. 24, 1902. Tappets adjacent to the rails open a local circuit and display danger signal. A mechanical connection retains such circuit opened until it is closed through a shunt circuit made by the actuation of the succeeding semaphore. The first signal then returns to normal position.

799,816. BLOCK SIGNAL SYSTEM; Harold E. White, Schenectady, N. Y. App. filed Feb. 11, 1904. The track rails are charged in each block by a local battery with a polarity which is determined by a pole changing switch mechanically operated from the caution signal of that block.

799,817. TELEGRAPHIC TRANSMITTER; Richard Wolters, Dusseldorf, Germany. App. filed Sept. 20, 1904. A Morse code transmitter operable by a typewriter keyboard in which the contacting sliders describe a four-motion path so as to make contact only on the up-stroke.

799,851. MOTOR VEHICLE; Ralph O. Hood, Danvers, Mass. App. filed Nov. 11, 1904. The longitudinal shaft of an automobile is provided with a magnetic clutch having an external gear with which meshes an electric motor. The vehicle includes storage batteries and a controller which can be manipulated to make the motor start the vehicle or to assist the engine in hill climbing. At other times the engine may drive the motor as a generator.

799,887. PARTY-LINE TELEPHONE SYSTEM; Mary A. Breadheft, Indianapolis, Ind. App. filed Feb. 24, 1903.

799,896. ELECTRIC CONTACT DEVICE; Robert W. Farrington, Buffalo, N. Y. App. filed Sept. 23,1904. The trolley wheel has its bearing surface formed by a series of pivoted shoes which are designed to successively make contact with the wire on their flat faces in order to secure a greater contact area than would be obtained by the plain surface of the wheel.

799,934. PROCESS FOR ELECTRICALLY WELDING RAIL-JOINTS; Carl Pahde, Breslau, Germany. App. filed June 30, 1904. (See Current News and Notes.)

799,957. HANGER FOR CABLE HEADS; Frank M. Winn, Des Moines, Iowa. App. filed Nov. 2, 1904. Comprises side bars having parallel portions from which the bars diverge so as to embrace and be secured to a telegraph pole. The opposite ends are bent to embrace the cable and have a bolt to connect the parallel portions and a stay-rod extending therefrom to the pole.

799,989. OUTLET BOX; Charles J. Klein, New York, N. Y. App. filed Sept. 23, 1904. A stamped sheet steel member has spring arms with teeth adjacent to the openings of the outlet box which engage the cables and prevent their withdrawal from the box.

800,022. TRAIN OPERATED TIME SIGNAL SYSTEM FOR RAILWAYS; William B. Severance, Manchester, N. H. App. filed May 29, 1905. The semaphore is operated by a time relay so as to be displayed for a certain predetermined period after the passage of a train.

800,052. CONDUIT FOR ELECTRIC WIRING; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A sheet metal conduit for interior wiring and designed to form an ornamental moulding. A three-sided sheet metal trough has a corrugated cover secured thereto by screws which engage cross braces within the trough.

800,053. ANGULAR CONDUIT FOR ELECTRICAL WIRING; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. An L-shaped sheet metal trough has its third side formed by an S-shaped strip which slides endwise over the trough so as to interlock therewith and at the same time present an ornamental appearance.

800,054. CONDUIT FOR ELECTRICAL CONDUCTORS; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A U-shaped sheet metal trough has ears thereon with which to engage corresponding projections upon the cover.

800,055. COVER FOR ELECTRICAL CONDUITS; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A still different form of conduit moulding in which the cover is very narrow and spring pressed into the longitudinal recess which it is designed to close.

800,084. ELECTRIC WATER HEATER; William C. Dice, Seattle, Wash. App. filed Dec. 6, 1904. A portable arrangement in which the heating coil is wound on a porcelain block within a perforated casing. The device is plugged to an ordinary lamp socket and immersed in a pail of water.

800,114. REGULATOR FOR ELECTRIC CURRENTS; Patrick Kennedy, New York, N. Y. App. filed Nov. 12, 1904. Especially designed for regulating dynamos geared to car axles. The controller arm is stepped around by a pawl and ratchet operated from a magnet which receives current intermittently under the influence of a rotating cam. The direction of the stepping movement is dependent upon a lever whose position is controlled by the intensity of the current.

800,117. ELECTRICAL INDICATOR; Hermann Lemp, Lynn, Mass. App. filed May 5, 1903. The steam from a flash boiler passes through a thermostat on its way to the engine including a steel rod within a copper tube. The relative movement closes one or the other of a pair of alarm circuits which notify the operator of the temperature.

800,118. CONTROL OF AUTOMOBILES; Hermann Lemp, Lynn, Mass. App. filed Jan. 13, 1905. (See Current News and Notes.)

800,119. COHERER; Walter W. Massie, Providence, R. I. App. filed March 27, 1905. (See Current News and Notes.)

800,128. GRID OR ELEMENT FOR SECONDARY BATTERIES; William Gardiner, Chicago, Ill. App. filed Aug. 22, 1904. (See page 570.)

Philadelphia Convention of the American Street Railway Association.

IN interest and attendance the twenty-fourth annual meeting of the American Street Railway Association, held this week at Philadelphia, ranks among the very successful gatherings of that body. Of predominant interest were the matter of the adoption of a new constitution and a reorganization of the association, and the announcement by Mr. C. F. Scott of the adoption by the New York, New Haven & Hartford Railroad of the single-phase railway system, accompanied by an order for 25 Westinghouse single-phase locomotives. The details of this announcement are given elsewhere in this issue.

The papers and discussions of the various societies, as noted below, were admirable, although it is believed that in coming years the association proper will provide a larger programme and bring a wider range of topics within its own specific arena of discussion. The exhibit of apparatus as a whole can only be characterized as the best the association has ever made, and here the subtle, strong influence of the Manufacturers' Association made itself felt. Notes of the exhibits themselves will be found elsewhere in our columns. The general setting was admirable, and the meeting hall was far enough away up stairs to be quiet all the time. The buildings of the Philadelphia Museum are of a solid, exhibition type, and thus the various concerns were encouraged to give a beautiful and substantial environment to their apparatus and wares, with illuminated signs, brass railings, handsome rugs and furniture and plenty of elbow room for inspection. The general public was somewhat conspicuous by its absence, so that contrary to frequent experience the street railway men were able to study things quietly and easily; and most exhibitors expressed a keen sense of relief in not having to encounter promiscuous throngs of miscellaneous people to whom the exhibit meant chiefly a chance to indulge in a wild and fevered chase after "souvenirs." There were, of course, some souvenirs, and neat ones at that, but they went where they will do the most good. While it required a long car ride and a short stage jaunt to get from the hotel to the Museum, the attendance at the exhibits was markedly excellent, and the arrangements were all carried out very efficiently, especially those for registration, issuing of badges, etc.

The chief comment called for by the exhibits is that due to the increasing solidity and massiveness of the apparatus shown. For example, one conspicuous feature consisted in the all-steel cars shown in various parts of the hall. The tendency in this direction, in view of such an exhibit, seems quite irresistible, so that while wooden cars may yet enjoy a long vogue, the steel car has evidently made a place for itself and will be used in rapidly growing numbers. In other respects "weight" was the keynote—in line construction, rails, insulators, motors and well-nigh every other constituent part of the system. Alongside such material as was shown during the week, as the standard of the art, most of that in use only a few years ago is toylike and trivial to a degree. Some lines indicated a fair approximation to that perfection which constitutes the best starting point for novelty and improvement on hitherto untried lines.

The exercises of the week were led off by the meetings of the American Railway, Mechanical and Electrical Association, extending over Monday and Tuesday. The parent American Street Railway Association took up the tenor of discourse on Wednesday and Thursday and the Street Railway Accountants' Association of America overlapped from Thursday into Friday and Saturday. These meetings with the Tuesday session of the American Association of Street Railway Claim Agents rounded out a very full week of work, supplemented by the annual banquet which was given on Thursday night in great style at the Bellevue-Stratford. The entertainments included a reception at the same hotel on Tuesday night; a big theatre party on Wednesday night; a vaudeville show with amateur talent on Friday night; trolley rides, dinner parties, etc. Numbered badges were issued to all delegates accompanied by coupon ticket books for all the trolley lines in the city.

Great credit for the general arrangements is due to President W. Caryl Ely and to Mr. John B. Parsons, president of the Philadelphia Rapid Transit Company; Mr. James Rawle, chairman of the Reception Committee; Mr. C. C. Peirce, chairman of the Manufacturers' Association Entertainment Committee; Mr. Edwin H. Baker, chairman of the Manufacturers' Finance Committee, and a host of others who worked with them. Mr. William Wharton, Jr., was chairman of the Exhibit Committee, Mr. George Keegan was its secretary, and Mr. Thomas K. Bell acted as director of exhibits, in charge of all details. The Western Union and Postal Telegraph Companies and the Bell and Keystone Telephone Companies extended special facilities to the convention and the delegates.

American Railway, Mechanical and Electrical Association.

POWER DISTRIBUTION.

The paper on this subject by Mr. C. H. Hile, describes the power distribution system of the Boston Elevated Railway Company. Only five of the eight stations on the system are considered, the three stations not considered being of obsolete construction. The five stations are fairly representative of the modern type of station, and include in their equipment direct-connected direct-current units varying in size from 800 to 2,700 kilowatts rated capacity. The total output of the five stations during the year was 124,876,492 kw-hours.

The several stations are tied together and operate in parallel. The tie between stations is accomplished through feeder wires running into so-called feeder sections common to two or more stations. The advantage of this arrangement is evidenced by the high load factor on the individual stations, which varies from .632 to .881, and by that on the individual machines, which varies from .817 to .929. It is stated that the cost of coal per ton at the several stations varies from $3.50 to $3.73, and that the average cost of energy for all stations is $.00778 per kw-hour. There are approximately 72 sq. miles of populated territory included within the limits of 12 cities and towns served by the company's lines. This total territory is divided into 64 feeder sections. By the use of section insulators in the trolley wires in connection with legs leading down from the trolley wires to switches, any two sections, or number of sections, may be tied together and run as one large section. There are installed 964 section insulators, and 1,540 switches. On Oct. 1, 1904, there were 424 miles of trolley wire and 16 miles of third rail being served by 806.5 miles of conductor.

About 32 per cent of the power distributing system is carried underground, all feeder cables and a large portion of the return copper being carried in conduits, and the balance of the return wires being buried in trenches or just outside the conduits. The total length of conduit is 28.4 miles, there being 683 manholes.

An experience extending over a period of several years shows that the installation and maintenance of underground cables cost more than with overhead lines, and the chances for trouble to the transmission system are greatly increased. The following figures are believed to represent a fair average cost per foot for complete installation ready for service:

Size of conductor.	Cost of inst. per foot.
500,000 cm.	2.0 cts.
1,000,000 cm.	2.5 cts.
2,000,000 cm.	3.25 cts.

The cost of maintenance per foot per year, which includes testing, inspection, repairs and changes, is from 1 ct. to 1.25 cts. Under fair conduit conditions and with proper care and usage, it is believed that the average life of an underground cable will be from 25 to 30 years.

The discussion of Mr. Hile's paper assumed the form of a conversation in which the author continued to reply to questions put by various members. To the query of Mr. L. P. Crecelius in regard to the form of terminal construction used where the overhead lines enter the cables, Mr. Hile stated that in order to afford protection from lightning two arresters are placed, one at at either end of the cable, and that these have afforded adequate protection. Very little trouble had been caused by lightning. An insulated conductor is run down an iron pole. Perhaps a wooden pole would prove better, on account of the lack of the great inductive effect found with the iron pole. Automatic circuit-breakers are used at the power station, the

circuits being so arranged that these will open in event of an arc being formed. When trouble arises, the defective feeder is at once located, and repaired, because complete plans of the feeder sections are available at numerous places for the repair men. Mr. H. H. Adams stated that observations, over an extended period during which all points on the circuits at which trouble had developed, had been properly recorded on a chart, had shown that the lightning caused damage most frequently at places where circuits crossed each other, such as at street corners. In reply to Mr. Adams' question as to the distribution of lightning arresters, Mr. Hile said that on the circuits of the Boston Elevated Railway Company, the arresters are placed approximately one mile apart. Mr. Chas. Hewitt, Mr. M. LeH. Smith and the author entered into a lengthy conversational discussion of the conditions under which compound-wound generators can be operated in parallel. In order that the generators may tend to equalize the load it is desirable that they be not over-compounded, that the tie conductor be not of too small resistance, and that the generator be connected together through feeders and not directly at the bus-bars. These conditions are obtained in the Boston circuits, and the service is quite satisfactory. Mr. Hile stated that as a general rule the cables are operated at loads which would correspond to not more than 200 amperes per 500,000 circular mils, and that no trouble had been experienced from overheating. In order to prevent leakage return current from traveling along the lead covering of the cables, the lead pipe has been cut to interrupt the electrical continuity. Each cut is about ¼-in. wide, the space being filled with pure rubber and insulating paint. The joints are frequently inspected and given fresh coats of paint, and no difficulty has arisen from any lack of insulation. Electrolysis is prevented by different schemes, according to the location. Numerous return wires have been installed. In some cases these did more harm than good, and such wires were disconnected. Trouble from moisture has been largely eliminated by placing the positive feeder cables in the top ducts and installing the return circuits in the lower ducts.

EFFECT OF LOAD FACTOR ON COST OF OPERATION.

The paper by Mr. L. P. Crecelius on "The Power Station Load Factor as a Factor in the Cost of Power," presented evidence to show the advantage of interconnecting several stations by means of bus-bars and shutting down certain ones completely during periods of light load. The author first discusses the character of the load on railway systems.

In urban railway systems the load curve is double peaked, having the characteristic morning and evening peaks of city travel when the people go to and from work; the breadth, magnitude and duration of these peaks depending, of course, upon local conditions, such as the size and lay-out of a town, and upon its sociology. In a manufacturing center the peaks are often remarkably symmetrical, and are little affected by climatic conditions, as the people usually go to work at about the same time in the morning and leave to go home at nearly the same time in the evening. In the larger cities, where it becomes necessary to transport a mixed community consisting of factory employees, merchants, clerks, shoppers, theatergoers, etc., the peaks lose their symmetry, the morning peak becoming lower and not so sharp as the evening peak.

The writer describes the system of the United Railways of St. Louis, which has in operation four power stations. Two of the larger stations, one of 13,950 kilowatts and one of 7,000 kilowatts capacity, are kept in operation continuously, and constitute the main central stations. The two smaller stations are operated on swing watches on week days, that is, operated during the peak hours only. Bus wires have been run from the larger stations to both of the smaller ones and there connected through circuit-breakers and double-throw switches to either one of the two feeder buses, with which the smaller stations have been supplied. Installing double-throw switches the feeder sections can be connected. During the rush hours the bus wires are connected to the same bus on which the stations are operated, thereby becoming equalizer wires. The amount of copper in the bus wires is just sufficient to carry the load of the smaller stations during the lighter part of the day, allowing a reasonable drop in potential.

The resulting economy of operation in this case more than justifies the expenditure of a good many dollars in the bus wires, and also the resulting increase in the cost per kilowatt hour of the power generated under this arrangement in the smaller stations. Thus it is found that in bringing up the load factor of the main stations from 50.23 per cent in the first case to 57.7 per cent in the second, that a saving of .000575 of a cent per kilowatt hour has been made on the total power cost. And on a basis of 310,000 kilowatt hours per day, which is about the average output of the stations of this system during the summer months, this would represent a saving of $178 per day when operating under these conditions.

It has been found that since the installation of a storage battery, which is located in the business district of the city where the traffic is very congested, the character of the service has been improved to a marked degree during the rush hours. Also a large reduction in the amount of copper required to handle the sections located in this district from the four stations has been effected. This, together with the fact that a battery can always be called upon in cases of emergency to take hold of the load, points to the advantages to be derived in using storage batteries to smooth up the load curve when conditions warrant their use.

In discussing his own paper, Mr. Crecelius stated that no difficulty is experienced in arranging for the operating force of the two small stations to report for duty twice per day during the morning and evening rush hours. Mr. H. LeH. Smith called attention to some of the more important items that depend upon the load factor. These include the electrical losses, the radiation losses from the stack, and the inability of automatic stokers to respond readily to rapidly fluctuating loads or to be adjusted for a great range of load. He thought a better definition of load factor than the ratio of average to maximum load could be found in the ratio of the actual energy developed to the maximum possible output of the station.

CONTROL APPARATUS.

The report of the committee on "Control Apparatus," of which Mr. J. S. Doyle was chairman, was rendered in the form of two papers, of which one on "Multiple Unit Systems of Train Control" was prepared by Hugh Hazelton, and the other on the "Series Parallel Railway Controller" was written by W. A. Pearson.

After giving some historical notes on the development of control apparatus, the paper of Mr. Hazelton deals at length with a comparison of the more important features of difference in design of the apparatus supplied by the Westinghouse and by the Sprague-General Electric companies.

In both systems independent switches, or contactors, are now used for closing and opening the main motor circuits. With these independent switches large current valves may be handled with greater safety and certainty than was possible with the drum type of controller, for a wider air-gap and stronger magnetic blow-out is provided, and the contacts of the independent switches open more quickly than was possible with the revolving drum controller.

In the General Electric contactor the contact fingers are closed and opened by a solenoid wound for line potential, which is operative between the limits of 300 and 750 volts. The advantages claimed for this design are simplicity and low cost of maintenance, by reason of the small number of working parts.

The Westinghouse contactor consists of a similar switch and blow-out coil, but an air cylinder is provided for opening and closing the contact fingers of the switch, and electro-pneumatic valves for controlling the admission of air to the cylinder. The valve magnets are energized by current at 14 volts potential, supplied by a duplicate equipment of storage batteries. In the present design the Westinghouse contactor provides a wider air-gap between the contact fingers when open, and greater pressure to the contacts when they are closed, than in the General Electric design. The amount of air gap and pressure necessary for satisfactory operation is, however, capable of definite determination, and with either solenoid or air cylinder operation results equally satisfactory may be secured. The rapidity of closing the contacts is less with air operation, and the wear resulting from the hammer blow correspondingly less. While the use of 14 volts potential for the operating circuits makes it necessary to install and maintain duplicate storage batteries on each motor car, there are compensating advantages, for the operation of the contactors is made independent of line voltage and of interruptions of current on the forward car. Another advantage of the independent operating circuit is the possibility of stopping the train, even in the unusual event of simultaneous failure of brakes and power supply, by reversing the master controller handle to multiple so that the motors are made to act as generators.

The current limiting relay, common to both systems, consists of a solenoid placed on each motor car through which the

current of one motor passes. The armature of this solenoid is attached to a contact disc which opens and closes the operating circuit for the main contactors. The operation of the current limiting relay may be described as follows: In starting the train the motorman usually turns his master controller to the full multiple position. The current is first completed to the contactors that connect the motors in series with all resistance in circuit. This connection is maintained, and the armature of the current limiting relay is drawn up until the counter e.m.f. due to the increasing speed of the motor armatures, causes the current in the motor circuit to drop to a value which no longer holds up the armature of the current limiting relay. This armature then drops and makes connection to the operating circuit of the next resistance unit. The contactors are thus interrupted in their progression at each successive step, so that a nearly constant amount of current is allowed to the motors during the period of acceleration until the motors are in full multiple without resistance.

The provision made in the master controller, of both systems of control, for opening the main circuit and applying the air brakes whenever the motorman releases the controller handle, is considered a valuable safety feature, and its application is so simple as to well warrant its use. The master controller on both systems is very small and compact, as it handles only the small currents of the operating wires. In the Sprague-General Electric system the control circuits require not over 2½ amperes at 600 volts, with two 125-hp motors, and in the Westinghouse system not over 10 amperes at 14 volts for a 10-car train.

In both systems a potential or line relay is provided which opens the main circuit whenever the supply of current from the line is interrupted. When the current is again restored to the line the contactors are closed through successive resistance steps before returning to their former positions. This device obviates the shock which would otherwise occur in passing over road crossings or turnouts where the continuity of the third rail is broken.

The prominent features of the multiple control system are the ability to run cars in trains of any desired length without reduction in speed, and without overloading the motors; the advantage of limiting the current during acceleration to a predetermined value, and of the decreased fire risk by placing the control apparatus under the car.

The paper of Mr. W. A. Pearson treats more specifically of equipments for cars intended to operate singly. The various steps in the development of the series-parallel controller are outlined, after which the statement is made that the final outcome of the series-parallel controller for street car service the present well-known K-type, which has been practically standard for about 12 years. This controller owes its success very largely to the form of magnetic blow-out employed, and to the method of making the transition from series to parallel. In this type of controller, after the motors have reached the full series position, a portion of the starting resistance is reinserted in the circuit and a shunt is put around the other motor. It was found that the arcing in this controller was too great to permit its use for large currents. For car equipments using more than 250 hp, there is used the type L, in which, instead of maintaining the current through one motor during transition, the circuits of both motors are broken. In the later "bridge method" the current is kept on both motors during transition.

There is a growing tendency to place controlling apparatus for large and medium size motors under the car. It removes the heavy capacity parts from the platform, and not only leaves a greater passenger space but also eliminates all possibility of danger from controller "explosions."

In discussing the report Mr. E. W. Olds pointed out that most of the accidents to the car circuits did not occur in the controller but elsewhere. Difficulty arose in the controller, however, on account of the fact that it was not able to rupture the arc. The circuit interruption should not occur on the platform but under the car. Experiments are now being carried on with some controllers which are arranged to open the circuit under the car in event of short-circuit. Each motor is provided with enclosed fuses of the no-arc type, placed under the center of car in a box. These fuses are designed to blow only on short-circuit, circuit-breakers being provided for ordinary overloads. This scheme is now being applied to 30 equipments each of four 40-hp motors for city service. Mr. Case stated that the removal of the circuit-opening device from the front platform is merely a partial step in the right direction. The proper solution of the problem of securing safety for the public lies in placing all of the control apparatus under the car and in using the equivalent of multiple-unit equipment. Mr. Adams remarked that all street railway companies are willing thus to place the apparatus, but the cost of multiple-unit control is too large. Mr. Olds said that the manufacturers have not devised apparatus which can be placed beneath small city cars. Mr. Hill pointed out that it is a difficult matter for a cylinder-type controller to withstand a 5,000-amp. short-circuit. To break such an arc requires more room than is available. The ordinary multiple-unit equipment cannot be used on small cars. Multiple-unit is ideal for heavy cars and for circuits where the heavy feeders from generators of large capacity will allow of dangerous short-circuit currents. There is now being developed a multiple-unit equipment for a four 40-hp motor car for the Brooklyn Elevated Railway. Multiple-unit for double-truck cars for city work is at least feasible, but, obviously, the cost will be large. Mr. Taylor described a recent development in the K-11 controller, which has been designed for simplicity. All heavy-current circuits are under the car body. The main controller is operated by a plunger electromagnet, the coil for which carries a very small current when the plunger has reached the end of the stroke. The controller operates automatically. The car is supplied with straight air-brakes. When the pole flies off the wire, the brakes are applied and the controller is returned to the "off" position. The motorman need not return his handle to the starting position when the pole is replaced on the wire. When the cost of the two platform controllers and of the necessary wiring for an ordinary equipment is considered, the new type of controller is found to be equally as cheap as the old.

RAIL JOINTS.

The paper by Mr. F. G. Simmons on "The Treatment of Rail Joints" consists of a collection of articles dealing with modern methods of treating rail joints in order to obtain high electrical conductivity and good mechanical alignment. The present most accepted methods are divided into two exact types: (First).—The mechanical joint, bolted, riveted or wedged, and connected by means of a metal bond in order to decrease the electrical resistance. (Second).—The various kinds of welded joints (thermit, zinc, electrical and cast). The author states that the most successful makes of the mechanical joints are the "Weber" and the "Continuous." These are briefly described. The major portion of the paper is devoted to the various welded joints, each described by a different writer.

The "Thermit" process is treated by G. E. Pellisser. Thermit consists of a mixture of powdered aluminum and oxide. If the mixture is ignited by means of a special ignition powder (peroxide of barium and aluminum), combustion proceeds without further supply of external heat and without any combination of oxygen of the air, at the same time developing a temperature estimated at 3,000 degrees centigrade. The chemical reaction is such as to produce pure iron and aluminum oxide. The iron separates from the aluminum oxide on account of its higher specific gravity. This iron, when poured upon the metals to be welded, has the property of uniting intimately with them, due to the very high temperature to which it is raised.

On a certain section of track of the Holyoke Street Railway Company, 170 Thermit joints were made in 107-lb. grooved rails. The cost per joint was about $6.23. This work has been down nearly a year and not a break has occurred, although the temperature has been as low as 10 degrees below zero. The wear throughout the rail is perfectly uniform. The alignment of the track has remained perfect, both on straight track and on a curve of 300-ft. radius. Tests show that the conductivity of the joints to be practically equal to that of an equal length of rail.

An account of results obtained in the cast-welding of rail joints by the Milwaukee Electric Railway & Light Company is given by F. G. Simmons. View are given of the apparatus required, including a utility car, a cupola car, and a sand-blast car. A mixture of three parts of good pig iron and one part of soft scrap is placed in the cupola and heated in the ordinary manner. The sand blast is used for thoroughly cleaning six or eight inches of rail end to be welded, since all scale as well as dirt must be removed. An absolute fusion of a portion of the ball and stem of the rail is necessary in achieving a successful cast-welded joint. The author states that of about 7,000 joints welded during the past three years, not one

has pulled or broken. Electrical tests show the conductivity to be from 100 to 140 per cent of that of the abutting rails. The total cost of a joint 95-lb. tee rail is about $3.50 for the joint proper and $1.00 for the opening and closing of the street.

A description is given of the process of electrically welding rail joints, as applied by the Lorain Steel Company, Lorain, Ohio. The first operation is that of sand blasting, which is done by means of a 10-hp motor-driven air compressor. The welder itself consists of an alternating-current transformer, the secondary circuit of which consists of one loop of copper and the rail joint to be welded. Of 5,308 joints welded in Rochester, N. Y., in 1901, there were but six broken rails in the spring of 1902.

The zinc process in use in Philadelphia was described by H. B. Nichols and C. B. Voynow. The joint consists of what may be called two Z-shaped bars which are riveted on to the web of the rail. These plates are not made to fit the fishing section of the rail; on the contrary, spaces are left under the head, tram and around the foot of the rail. These spaces are filled with molten zinc, which enters into and fills out all the irregularities of the rolled surfaces, thus giving an absolutely continuous and perfect bearing throughout the whole length and width of the flanges of the plates. It is obvious that such a continuous contact could not be obtained by the most laborious machining or milling of those surfaces. The adhesion of the molten zinc to the rails and plates, together with the body-bound rivets, hold the joint permanently tight, and at the same time prevent expansion, thus making the rails continuous.

In comparing the several processes of welding and joining the rails the following summary is given: The electrical welding operation appears undoubtedly to require the most cumbersome and very much the most expensive equipment, to such an extent, indeed, that, except in case of the very largest systems, private ownership would be virtually impossible, and all work would necessarily have to be done through contractors. The zinc joint appears to rank next in point of expensive apparatus, but is followed very closely in this respect by the cast-welded joint. The thermit welding process certainly requires very much the least expensive apparatus, and from this viewpoint stands in a class by itself. It is believed that under the present conditions the cast-welded joint is the most economical, from the viewpoints of both the mechanical efficiency and the actual monetary expense.

Mr. W. B. Reed said that the rail joint had always been the "thorn in the flesh" in railway work. He outlined the development in splice bars. It is impossible to keep bolted joints tight, and the rail ends wear much more rapidly than other portions of the rails. When the continuous rail was first suggested, old railroad men believed that troubles would arise from expansion and contraction. When the rails are laid in concrete, no such trouble is experienced. On certain cross-town lines in New York City, where the rails are continuous from street to street, the slots at the crossings have been found closed on the hot days, but they will open at once when water is thrown upon the rails in the immediate neighborhood of the slots, thus showing that the rails do not expand within the concrete. The objections to welding rails reside in the large amount of apparatus required. A proper cast-welded joint is perhaps the best that can be obtained, but the process is objectionable on account of the numerous conditions which affect the weld and yet cannot be controlled. Experience has shown that "thermit"-welded joints break through the old bolt holes, but the weld itself is perfect. The thermit joint supplies a real continuous rail without excess of metal. In reply to a question of Mr. Paul Winsor, it was stated that the temper is not removed from the head of the rail because the head reaches only a cherry-red temperature. Mr. Sloan said that in Chicago the price for each cast-welded joint was found to be $2, which would be about 2 cents per pound for the material used. Under proper conditions the cast weld is of sufficient strength to break a 7-in. rail. Mr. Simmons stated that in certain old tracks the cast-welded joints were found to be higher than other parts of rail. This condition is to be explained by the fact that the rail wears more rapidly than the welded joints. Mr. Pratt said that of the 15,000 or 20,000 cast-welded joints in Newark, very few had been found defective. The cost of the weld is from $3.23 to $3.48 per joint for a 7-in. rail. It was explained that the estimate given in the paper for the cost of thermit joints is based on a 9-in. rail. The cost for a weld in a 5-in. rail is much lower, and average about $3.30. Thermit works best on new rails. The thermit process is desirable on account of the small outfit needed. Mr. Clarke stated that only eight men were needed for welding by the thermit process. These men can weld as many as 46 joints per day. From 2,000 to 2,800 joints have been completed. No failures have occurred since a composition of 8 pounds of thermit to 1 of punchings has been used. The conductivity averages from 90 to 100 per cent. No bonds are used on the joints, but the rails are cross-bonded. Mr. Kleinsmith explained the electrically-welded joint. Railway men do not get acquainted with the electric process because the apparatus is not sold, but is operated by the contractors who are paid for the completed joints. With this process it is possible to eliminate trouble at the bolt holes by using long bars. The process does not require that the street be opened below the rail. About 1,200 joints are now being welded per week. Each joint is fully guaranteed.

ELECTRICAL EQUIPMENT.

The committee on the "Maintenance and Inspection of Electrical Equipments" did not submit a complete report at this meeting, but stated its intention of doing so at the next. The chairman, Mr. William Pestell, explained that all railway companies of the United States had been written to in order to ascertain the methods in use. The result had been only fairly satisfactory, and more time is needed to complete the work. He drew attention to the present lack of uniformity of equipments, and suggests the desirability of standardization. Mr. Doyle stated that the New York railways had saved considerable money by standardization on account of less labor and more easy inspection. He expressed the opinion that the standardization of parts would prove one of the most valuable features of the association. Mr. Olds said that in Milwaukee all mechanical parts had been standardized. All axle boxes and brake shoes have been the same for all cars for the last few years. He thought that standardization of new equipment is most desirable, but that it is not practicable to standardize old equipment. Mr. Winsor discussed the proper method for timing the inspection of cars and suggested that a mileage basis would be preferable to a time basis. This plan is followed in Boston. In St. Louis a record is kept of the mileage of each car, which information is particularly useful in judging of the life of bearings. Mr. Stearns stated that in Chicago all parts of each equipment are inspected once per week. Each car requires the work of one man for ten hours.

POWER STATION.

The paper by Mr. Fred N. Bushnell on "The Power Station" was read by title, the author not being present. The paper describes the modern station as one which in its simplest form consists of a boiler room, engine and generator room and switchboard gallery, arranged in parallel lines and separated from each other by substantial fireproof walls. The requirements imposed upon the designer in the selection and installation of power house equipment are treated in detail. In discussing the steam turbine the author states that the remarkable progress made in the manufacture of these machines and their general adoption by many of the most progressive railways in the country, proves them to be a most formidable competitor of the reciprocating engine, if indeed it does not indicate that they have already established their commercial superiority.

It is to be regretted that most of the information concerning the efficiency of steam turbines has been derived from tests covering very short periods of time, usually only a few hours, and that so little information is available as to their performance under actual service conditions. To the street railway manager or engineer, power station records for long periods, showing the coal consumed per kw-hour, or, better still, the efficiency of the plant expressed in percentage of heat energy in the coal converted into electrical energy at the switchboard, are of much greater interest and value than the record of any number of short-time tests for steam consumption only. As an example of a steam turbine plant the Quincy power station of the Old Colony Street Railway Company is cited. This station contains five 2,000-kw, four-stage vertical turbines, running at 750 r.p.m., and connected to 13,200-volt, 25-cycle, alternating-current generators. The steam pressure is 200 pounds. There are ten horizontal water-tube boilers of 750 hp each, equipped with internal superheaters, giving to the steam an average of 65° superheat. Underfeed stokers are used. There are no economizers. One turbine is supplied with steam-driven auxiliaries; the other four have motor-driven auxiliaries. At present, while only two units are in operation, the feed water is heated to 200° F. by the exhaust from the steam auxiliaries. The average daily output is 52,500 kw-hours, giving a load factor of 54.7 per cent for the two machines. Georges Creek Cumberland coal is used, having an average calorific value of 14,000 B.T.U. per pound. The average coal consumption for this station, operating

under the conditions outlined above, is 2.94 pounds per kw-hour, showing an efficiency of 8.36 per cent. This record covers a period of six months, ending June 30, 1905.

At the Rhode Island Suburban Railway Company's Manchester Street station all of the usual records are kept, and the quantities and costs carefully determined for each month, and tests of the entire plant are also made. It is believed that these tests have a sufficient influence upon the regular performance of the station to justify a brief description of it, and the publication of the results in the matter of coal consumption from the time it was placed in commission, showing the gradual improvement in efficiency.

This station was originally designed for the Rhode Island Suburban Railway Company to furnish power for its lines operating in the vicinity of Providence. It was intended to use horizontal units, and two 1,500-kw alternating-current units and one 1,600-kw, direct-current unit were purchased. Before work on the building had progressed beyond the foundations, however, it was decided to increase the capacity of the station by installing two additional direct-current units of 2,500 kw each. This required a number of changes in the structure, and necessitated double-decking the boiler room in order to provide the necessary additional boiler capacity. The present equipment of the station consists of fourteen horizontal water-tube boilers of 520 hp each, eight on the lower floor and six on the upper floor. The boilers on the lower floor have no superheaters, but those on the upper floor are equipped with internal superheaters, each made up of 84 2-in. tubes suspended below the boiler drums. The superheaters on two of the boilers were designed for only 125° of superheat, and contain 615.3 sq. ft. of effective heating surface each. Those on the other four boilers were designed for 150° of superheat and contain 255.5 sq. ft. of heating surface. Each boiler has 5,159 sq. ft. of heating surface.

The following is the performance of the station under actual service conditions from the time it was started in regular service, February, 1904. It should be borne in mind that the first battery of boilers with superheaters was installed eleven months after the station was started, and four months thereafer two additional batteries of boilers with superheaters were commissioned, and the performance of the station is, therefore, given for the periods covered by these different conditions.

Eleven months, saturated steam, 2.87 pounds of coal per kw-hour. Four months, slightly superheated steam (no record of temperature kept), 2.37 pounds per kw-hour. Three months, superheated steam, average temperature at engine throttle 465° (102° superheat), 2.46 pounds of coal per kw-hour. The apparent reduction in coal consumption per kw-hour with steam superheated about 100° is 14.3 per cent, but all of this saving cannot be attributed to this cause. A large part of it is undoubtedly due to the increased efficiency of the fire room attendants. Probably not over 8 to 10 per cent should be credited to the use of superheated steam.

In opening the discussion, Mr. H. Le H. Smith said that it was astonishing to hear that with engines operating with superheated steam the efficiency as given in the paper is not high, although the station is of modern design. He said that in a certain old station where low-grade coal is used and where the steam is not superheated, an efficiency almost as high is obtained. It is to be doubted if there is a very marked economy with superheat when the coal consumption of the auxiliaries is considered. The real test of efficiency is the pounds of coal per delivered kw-hour. Mr. Green discussed the detrimental effect of superheated steam upon lubrication and doubted if there could be obtained any beneficial results from its use. In reply to a question by Mr. Winsor, Mr. C. O. Mailloux stated that centrifugal pumps are now being used in Europe for station auxiliaries. He has been informed that they will soon be obtainable in this country. He stated his belief that the lubrication of cylinders using superheat would be solved by adopting some form of graphite. Mr. L. R. Nash said that experiments over a period of two years had demonstrated that a graphite compound makes an excellent cylinder lubricant. The cost is very moderate and no trouble is experienced from deposit on the walls.

TRACK BRAKE.

The paper on this subject by Mr. F. F. Bodler was presented in printed form and not read. It illustrates and describes an emergency track brake which is used on practically all the cars in San Francisco. The brake mechanism consists of a wooden shoe, about two feet in length, which is forced downward against the rails by means of toggle levers operated by the motorman. Channel irons are so arranged as to allow the shoe to travel in only a vertical direction. The shoe is made of Oregon pine. It costs about 2¾ cents and lasts about one week. Each shoe is held in place by a shell made of pressed steel in two parts. Two bolts which pass through holes in the shell, and through recesses in the shoe, not only clamp the shoe by means of the shell, but also prevent the shoe from slipping backward or forward. The brake was originally intended to be used only in emergencies, but it has proved so satisfactory that it is used almost as much as the wheel brake. It ought not to be used on curves, switches or crossings, but should it be used about the only damage resulting would be a split shoe.

Mr. Paul Winsor thought that a brake which could not be used at curves, switches or crossings would seldom be in use, for practically all of the track in cities consists of such construction. Mr. Dewson said the use of Oregon pine involved an increased coefficient of friction to which increase the effectiveness of the new brake could be attributed, since if iron were used there would be no advantage in the type of brake described. In the magnetic track brake, however, there is an actual increase in force on the rail so that the frictional force is greatly augmented. Mr. Schreiber and Mr. Bridge described the good results which have been obtained with magnetic brakes on the West Pennsylvania Railway. It was found that the air brakes were not capable of holding cars on a certain 14 per cent grade where the rails were covered with soot. The air brakes were removed and magnetic track brakes substituted therefor and no further trouble has been encountered.

Abstracts from the "Question Box" were discussed by N. W. Storer, L. R. Nash, A. Green, E. W. Olds, W. H. McAloney, C. O. Mailloux, W. Wallerstedt, J. R. Cravath, H. H. Adams, J. S. Doyle. The questions discussed dealt with lubrication.

The following officers were elected: President, H. H. Adams, Baltimore; first vice-president, F. G. Simmons, Milwaukee; second vice-president, J. S. Doyle, New York; third vice-president, Paul Winsor, Boston. Executive Committee—W. H. Twining, Philadelphia; F. N. Bushnell, Providence; W. B. Reed, New York; A. D. Campbell, Seattle.

American Street Railway Association.

The session on Wednesday morning was devoted to the American Street Railway Association before which were presented three papers, abstracts of which are given below.

LARGE GAS ENGINES.

The paper by Mr. Arthur West was given the title "Notes on the Design of Large Gas Engines with Special Reference to Railway Work." The author stated that the smaller sizes are unsuited to important electric railway installations on account of first cost, multiplicity of parts and greater expense for attendance, etc. The tendency of the modern plant is constantly in the direction of large size units. This is indicated by the rapid increase in size of steam turbines installed in modern stations. Similar reasons will, it is believed, cause a demand for large size gas engines for electric railway work in conjunction with producers to operate them.

One of the most important considerations in the design of large gas engines is the arrangement of the cylinders. In a single-cylinder single-acting, four-cycle engine an explosion takes place once in every two revolutions. In order, therefore, to get the same rotative effect as with a double-acting steam cylinder, it is necessary to work four single-acting cylinders on the shaft or two double-acting gas cylinders tandem on one crank pin. With this arrangement four explosions are obtained in two revolutions, or an explosion every 180° of crank angle. In case of a misfire or premature ignition due to bad gas, the crank can only move one-half a turn before another explosion takes place. In a single-cylinder single-acting engine the crank must move two whole turns before the next explosion, while with two single-acting cylinders opposed to each other or one double-acting cylinder the crank may be required to move one and one-half turns before the next explosion. The relative evil effects of a premature or misfire are, therefore, in the following ratios:

Two double acting cylinders	1
Two single acting cylinders, opposed type	3
One double acting cylinder	3
One single acting cylinder	4

Gas engines and producers to be commercially successful must be designed to be run with the same class of help as is employed on Corliss engines and boilers. This being the case, misfires and prematures are liable to occur occasionally, and the designer must min-

imize their possibilities for evil. These considerations, as well as the capacity for caring for heavily swinging railway loads, have caused our adoption of tandem double-acting cylinders for railway work.

It is sometimes argued that cylinders so arranged are inaccessible. If, as is the practice of the Westinghouse Company, ample space is arranged between the cylinders, and if the inlet and exhaust valves are not located in the heads, but in the cylinder body and entirely above the floor level, such a gas engine is as accessible as a tandem compound Corliss engine or as a Corliss engine driving an air compressor.

The question is frequently asked as to whether large gas engines will drive alternating-current generators successfully in electrical synchronism or "parallel." This has been done for several years past in Germany with entire succes, and it has also been done in a number of instances very successfully by our company. We have at the present time orders for several such plants on our books, one of which is to drive an electric railway from Warren, Pa., to Jamestown, N. Y., which we expect will be in operation some time during the autumn.

We are frequently asked, "What is the overload capacity of your gas engine?" A clear understanding on the part of the purchaser of the limitations in this direction is very desirable, from the point of view both of the buyer and the seller. A gas engine and producer is thermally very much more efficient than a steam engine and boiler. It is, perhaps, not amiss to say that, with a well-designed producer and gas engine plant, a horse power can be delivered with one-half the cost of fuel that is possible with a well-designed steam engine plant. The power of the gas engine, however, is limited by *the total volume of explosive mixture which can be drawn into the cylinders* during the suction stroke, compressed and finally ignited. This condition sets a limit which does not allow of a large temporary increase of the power, such as obtained with the Westinghouse steam turbine by the automatic operation of the secondary admission valve. Such overload capacity is, of course, convenient for the purchaser, but it is unobtainable on a gas engine, unless the engine is largely under-rated, and the purchaser should consider that this is one of the prices that he pays for the enormously increased output obtained with the gas engine per pound of coal. *The overload capacity is, therefore, simply the amount which the builder rates his machine below its ultimate capacity.* It has been our practice to rate our gas engines in such a way that they would have a safe overload capacity of 10 per cent. Our machines are ordinarily good for somewhat more than this, but conservative engineering requires that there be a margin of power in order that overloads may not materially reduce the speed. The above remarks on overload furnish a general guide which may be of service in selecting suitable generator capacity for a gas engine. For ordinary cases the overload capacity of the generator and that of the gas engine should be about equal, although the gas engine will indefinitely carry its overload while the generator will not, in all cases, unless it is bought with that understanding.

The mechanical efficiency of a large gas engine is very much greater with a four stroke cycle than with a two stroke cycle, this being one of the arguments against the two cycle engine. It is no uncommon thing to see two cycle engines which do not realize as brake horse power more than 60 per cent. of the work actually done by the combustion in the cylinders. The efficiency of a four cycle engine varies considerably, but it may be said in a general way that a well-designed engine will deliver about 85 per cent of the gas indicated horse power in the form of brake horse power.

The thermodynamic efficiency of the gas engine varies so much with different kinds of gas that it is hard to say just what the average value would be. It is probably not far from the truth, however, that its thermal efficiency is about 25 per cent, though in favorable cases gas engines have obtained efficiencies well over 30 per cent.

The large size gas engine has come to fill such an important place in Europe, and has there proven itself to be so reliable and serviceable, that there is no question about its being adopted in this country in the near future, in a form suited to American operating conditions.

APPLICATION OF GAS POWER TO ELECTRIC RAILWAY SERVICE.

The paper on this subject by Mr. J. R. Bibbins outlined the characteristics of street railway service and discussed the adaptability of the gas engine and producer plant to meet the severe requirements. Owing to the limitations of gas engine capacity, dealt with in the paper by Mr. West, there is needed storage capacity at some part of the system. Electric storage is evidently the most desirable, as it relieves the machinery of the wear and tear of fluctuating loads. As to the fuel consumption of gas as compared with steam, it is stated that taking a common heat valve for average bituminous coal at 13,000 B.T.U. per pound, the gas plant requires less than 2 pounds for kw-hour, while steam requires 5.5 pounds. These data are based on tests made at St. Louis by the Government. Tests made at Guernsey, England, showed that the gas plant consumed about 2.25 pounds of coal per kw-hour and the steam plant used 5.5 pounds. The comparative cost of labor and supplies for gas and steam plants is difficult to state in definite terms. With the same character of labor there should be no appreciable difference between the two. In regard to maintenance it may be stated that in the station at Bradford, Pa., which has been in service for more than six years, the average cost of repairs on the engines for the last two years has been 11.6 cents per hp-year, or .0125 cents per kw-hour generated. The author states his conclusions as follows:

1st. That the gas engine has been brought to a state of development where it is capable of doing the same work as the steam engine, with far greater efficiency, and usually at reduced cost.

2d. That the producer has been so far perfected as to be a reliable and more efficient generator than the steam boiler.

3d. That the gas power plant "in toto" is entirely suitable for even the severe service incident to electric railway operation.

4th. That is component parts, engine and producer, are possessed of characteristics leading to harmonious co-operation.

5th. That practical difficulties incident to gas power working have been so far overcome as to warrant commercial confidence.

6th. That experience with gas power in almost every known line of modern industry has proven its general sufficiency for any power service.

SINGLE-PHASE RAILWAY.

The paper by Mr. C. F. Scott on "The Single-Phase Railway System," presented some of the salient features of the single-phase railway system, and the results of the work which has been accomplished in the development of apparatus to meet the increasing demands in electric traction. In discussing the field for the single-phase railways the author stated that the direct-current interurban railway has its limitations. If a region be sparsely settled the available traffic will not show a profit on the cost of circuits and rotary converter sub-stations. There is a material reduction in the investment and operating expense incident to the single-phase railway that will enable it to be built and operated with a profit in cases where the traffic would not support a rotary converter system.

On the other hand, in heavy service the direct current has not made much headway, being handicapped by the heavy cost of sub-stations and of conductors. Heavy and relatively infrequent trains are the hardest loads for sub-stations. For example, if sub-stations be 8 miles apart, each will supply 8 miles of track. A train running 40 miles per hour will receive current from a given sub-station for 12 minutes. In order that a sub-station may be continuously supplying current to trains in one direction they must have a headway of 12 minutes. If they be an hour apart the current from each sub-station is used but one-fifth of the time. Trains in two directions will double the sub-station output, but as the peak load is considerable when two trains pass near a sub-station the load factor is extremely low. Therefore as the aggregate capacity of the sub-stations must be large in proportion to the actual power taken by the cars, it follows that the sub-stations will involve a relatively large expense if they are equipped with expensive rotary converters and require constant attendance, whereas the cost will be relatively small if they require simply lowering transformers having an efficiency very much higher than the rotary converter sub-station and not requiring attendance. The reduction in the sub-station is therefore of especial value when the service is infrequent. Moreover, the single-phase equipment by reducing the size of conductors frequently enables the sub-stations to be more widely separated. This possibility in the reduction in the number of sub-stations and in the aggregate capacity of sub-station equipment, as well as the elimination of rotary converters with their energy losses and their attendants, makes practicable the operation of long-distance roads which could be operated by direct current only at an excessive cost.

The most notable recent event in electric traction is the purchase of Westinghouse single-phase locomotives by the New York,

New Haven & Hartford Railway Company. The passenger trains on this road which enter the Grand Central Station in New York run over the tracks of the New York Central Railroad for about 12 miles. As steam locomotives cannot enter the new terminal station, and as the New York Central is equipping its track for direct current, it is imperative that the New Haven trains be handled over 12 miles by direct-current power. Instead of changing from electric to steam locomotives for all local and through trains at the end of 12 miles it was decided to extend the electrification and to do it, not by extending the direct current, but by changing to alternating current. The single-phase locomotives will be designed so that they may operate interchangeably from direct current or from single-phase alternating current.

The adoption of the single-phase system by one of the leading railroads of the country for its heavy and important passenger service is all the more noticeable: First, because its officials are already familiar with electric traction matters through the operation of many important city and interurban railways in New England, and second, because the obvious thing to have done would have been to follow the example of the New York Central by adopting direct-current locomotives. Probably this is the turning point, and the coming electrification of heavy railways will follow the conspicuous example set by the New York, New Haven & Hartford Railroad Company in adopting the single-phase system.

EXHIBITS.

The exhibits at the twenty-fourth annual convention of the American Street Railway Association were made under very favorable auspices in one of the fine main buildings of the Philadelphia Museum at West Philadelphia, where they were housed and displayed very effectively, most of the exhibitors having gone to lavish expense in the way of setting and decorations. In fact, the display had nothing of a hasty, ephemeral character about it, but was such as is made for a national fair of months' duration. Appended are items with regard to the leading electrical exhibits of interest to our readers:

THE GENERAL ELECTRIC COMPANY'S display covered a large space in the main aisle of the large hall in the north of the building. The company exhibited many of its latest products in the railway field, and for the first time at a street railway convention showed a Curtis steam turbine. The exhibit includes a special car equipment for use on either direct or alternating current, with air compressor, motors and control in operation. The air compressor is designed for operation on alternating current and supplies air for the braking system. GE-505 motors were supplied with this equipment. The necessary alternating current for the motors is furnished by a 200-kw rotary converter running "inverted" from the 500-volt, direct-current circuit. On another frame was shown a two-motor Sprague-General Electric multiple-unit control, similar to those in operation on the Boston Elevated Company's lines. In addition to railway motor equipments, various General Electric railway single motors were shown, including the GE-80, GE-87, GE-66 and GE-69. Railway supplies were also on exhibition. These included field and armature coils in various stages of construction, giving a good idea of the care used in their manufacture, as well as the general structure. The company's lines of "catenary construction" material were also shown, as well as the various types of rail bonds. Aside from this car equipment material, a 500-kw Curtis steam turbine was shown, dismantled, so that it was possible to see its general construction. A 25-kw turbo-exciter represented the company's development of this type of apparatus, and a voltage regulator, an advance along another line. Both the latter were "still" exhibits. Various types of circuit-breakers completed this general class of apparatus. The entire exhibit was lighted by the new "G.E.M." lamps and enclosed arcs. The mercury arc rectifiers operating in parallel supplied current for the sign and general lighting effects. A feature of this exhibit which particularly attracted the attention of practical electric railroad men was a pair of GE-69 (200-hp) railway motors loaned by the Interborough Rapid Transit Company, of New York. These motors have been in continuous service since their installation on October 2, 1903, and December 10, 1903, respectively. One motor had been operated 45,248 miles and the other one 53,005 miles. The General Electric Company's representatives at the Philadelphia convention included the following: General Eugene Griffin, Messrs. J. R. Lovejoy, W. J. Clark; W. B. Potter, B. E. Sunny, J. G. Barry, L. R. Pomeroy, C. C. Pierce, J. C. Calisch, G. D. Rosenthol, A. H. Armstrong, F. E. Case, H. L. Monroe, J. H. Livsey, J. W. Buell, W. G. Carey, J. J. Mahoney, S. W. Trawick, F. H. Gale.

ALLIS-CHALMERS COMPANY, finding it, of course, impracticable to erect and exhibit, for one week, a 6,000 or 8,000-hp engine and generator, or any of its huge apparatus, confined their efforts to welcoming the visitors in a large and attractive reception room which it had fitted up in the Museum hall, at the foot of the stairs leading to the Convention Hall. Here, and also at the Bellevue-Stratford, where its representatives dispensed courteous hospitality throughout the several days of the meeting, the Allis-Chalmers badges and watch-fobs, reproducing in oxidized silver the Liberty Bell, and bearing the company's well-known "Four Powers" trade-mark, were worn by hundreds of the visiting railway men. The Allis-Chalmers representatives at the convention were Mr. F. C. Randall, manager New York office; Mr. G. B. Foster, manager Chicago office; Mr. George H. Berg, manager Boston office; Mr. J. W. Murray, manager Pittsburg office; Mr. W. S. Doran, manager power department, Milwaukee, Wis.; Mr. B. A. Behrend, chief electrical engineer, Cincinnati, Ohio; Mr. Charles E. Lord, electrical patent counsel, Cincinnati, Ohio; Mr. David Hall, assistant chief electrical engineer, Cincinnati, Ohio; Mr. A. H. Whiteside, manager Philadelphia office; Mr. C. C. Buttenfield and Mr. H. A. Moore, Philadelphia office; Mr. D. W. Pulver, manager Buffalo office; Mr. L. C. Marburg, Milwaukee, Wis.; Mr. Arthur Warren, manager of publicity, Milwaukee, Wis.

ALBERT & J. M. ANDERSON MFG. CO. showed its complete line of overhead materials, "Aetna" railway insulators, etc., a 4,000-amp. switch and one of its pure cast copper terminals. It was ably represented by Mr. Ernst Woltmann and Mr. A. E. Meixell.

GOULD STORAGE BATTERY COMPANY was represented by Mr. D. W. Winship and Mr. W. S. Gould. The exhibit consisted of its large size S-49 lead-lined battery and an interesting display of plates of various types for stationary and automobile batteries; besides which a number of photographs of electric railway installations made by this company attracted considerable attention.

LORD ELECTRIC COMPANY, maker of the Shaw non-arcing lightning arresters and static discharges, which business it took over recently and enlarged, exhibited a line of instruments for direct-current and alternating-current work, rail bonds and other specialties.

OSBURN FLEXIBLE CONDUIT COMPANY exhibited its conduit in various sizes and distributed literature calling attention to its toughness.

H. W. JOHNS-MANVILLE CO. had a very attractive exhibit, among which was a complete line of overhead line materials, a full line of "Noark," Standard and National Electrical Code standard fuses and blocks; its asbestos and magnesia coverings, a varied line of molded insulating material, "Monarch," etc., a line of high-voltage insulators and "electrobestos" fire-proof insulation and "Transite" asbestos fire-proof lumber. The two latter mentioned materials attracted a great deal of attention, as they are being so extensively used now, in connection with fire-proof construction of cars. The exhibit was looked after by Messrs. J. W. Perry, H. E. Manville, T. T. Lyman, D. T. Dickson, H. M. Voorhis, H. M. Clymer, J. E. Meek, C. N. Manfred, E. B. Hatch and W. W. White.

STERLING VARNISH COMPANY displayed armatures and field coils insulated with "Sterling" extra insulating varnish and "Sterling" black plastic insulator, finished with "Sterling" black air-drying varnish and extra black finishing varnish. This company distributed ships of copper coated with "Sterling" black iron enamel. It was represented by Mr. A. S. King and Mr. C. L. Cool. Mr. James Todd, president of the company; Dr. Riddle, vice-president, and Mr. Arthur Hartwell, general manager, attended the convention.

WESTERN ELECTRIC COMPANY and the D. & W. Fuse Company exhibited together, the former exhibiting a full line of overhead railway material, and the latter a full line of fuses, transformer cut-outs, service switches, cut-out boxes, etc. Demonstrations were made of the usefulness of their "Deltabeston" magnet wire. Messrs. R. H. Harper, F. D. Killon and F. C. Jaeger represented the Western Electric Company, while Messrs. W. S. Sisson and C. F. Harmon took care of the D. & W. Fuse Co.'s interests.

ELECTRO-DYNAMIC COMPANY exhibited a 5-hp, 500-volt, inter-pole, variable-speed motor with a speed variation of 4 to 1 (350 to 1,400 r.p.m.), belt-connected to a 5-hp generator; a 110-hp and a 220-hp motor. Messrs. G. H. Condict and F. G. Bell were in charge.

ELECTRIC STORAGE BATTERY COMPANY exhibited one of the cells to be installed by the New York Central & Hudson River Railroad, of which there will be 20,000 hp; one of the cells of the type installed

for the electrification of the Pennsylvania Railroad; one of the batteries being now installed at Hammel, L. I.; power house and line switchboards, the former showing the carbon regulator designed by the Electric Storage Battery Co. for booster control; also a 75-kw booster, an automatic cell-filling device, a recording hydrometer, a signaling hydrometer and a compensating hydrometer; also cell-testing apparatus. The company was represented by Messrs. Blizzard, Albert Taylor, H. B. Gay, F. J. Stone, Reynolds, E. L. Woodbridge, G. H. Atkin, F. L. Kellogg, and R. C. Hull.

MERRITT & Co. showed a line of expanded metal clothes lockers of various styles enclosed in an expanded metal booth.

NATIONAL CARBON COMPANY displayed samples of its carbon brushes, headlight arc carbons, Columbia dry batteries and flash lamps. The company was represented by N. C. Cotabish, A. D. Spear and A. E. Carrier.

BENJAMIN ELECTRIC MFG. COMPANY exhibited a line of Benjamin car clusters and steel shades, its street lighting fixtures, weather-proof sockets., and its new turn-down arc-burst cluster. The exhibit was energetically explained by Mr. Basil G. Kodgbanoff, of its New York office.

NATIONAL ELECTRIC COMPANY had a large booth in which was exhibited an auto-starter for a 200-hp induction motor, a 10-hp motor weighing only 575 pounds, its air brake devices, its switchboard apparatus, a motor-generating set, 250-volt, direct-current generator connected with an induction motor, its new engines, slide-valve and new type E-3 governor. It also exhibited a 20-ft. car air-compressing outfit to operate upon either single-phase, alternating or direct current, together with an alternating-current governor. It was represented by S. I. Wailes, William W. Power, J. T. Cunningham, J. H. Denton, J. F. Perry, C. N. Leet, C. G. Burton, F. L. Waters, W. H. Goble and Walter G. Clayton.

JORDAN BROS. exhibited their device for turning commutators without removing the armature.

THE CHICAGO PNEUMATIC TOOL COMPANY, in addition to its well-known pneumatic tools such as riveters, hammers, drills, etc., exhibited its new pipe-bending machine for conduit work. The company was ably represented by Messrs. J. W. Duntley, W. O. Duntley, Thomas Oldcorn, W. P. Pressinger, G. A. Barden, J. M. Towle, C. B. Coates, F. C. Severin, Julius Keller and B. H. Tripp.

CROUSE-HINDS Co. exhibited its time clocks, headlights, guy anchors, switches, Norbitt specialties, etc. It was represented by Messrs. James H. Hurd, W. D. Hawley, Nathan Shute and Frank Buchanan.

DEARBORN DRUG & CHEMICAL COMPANY made a novel display under the heading of "The Dearborn vegetable treatment for boilers," consisting of a table full of nearly every known vegetable, calling attention to its "vegetable boiler compound." The booth was ornamented with photographs of its laboratories, a free telephone service was supplied for its friends, and a warm welcome was extended by Messrs. Robert F. Carr, William B. McVicker, Grant W. Spear and Thomas Brannan.

PEERLESS RUBBER MANUFACTURING COMPANY had an attractive display of Peerless packing, Rainbow packing, Eclipse gaskets, Wizard gaskets for use with superheated steam, rubber tiling and step-treads. It was represented by Messrs. W. J. Courtney, F. O. Donnell and J. L. McGilvray.

STANDARD PAINT COMPANY showed samples of its "P. & B." insulating tape, "Ruberoid" roofing, "S. P. C." armature varnish and "Flexite" metal paints. Their merits were explained by Messrs. Paul M. Wade, Charles Earnshaw, James M. Richards and Ralph L. Shainwald.

THE BUCKEYE ENGINE COMPANY had a tastefully arranged reception booth, decorated with photographs of the various types of Buckeye engines, where flowers were supplied to all comers. The genial Mr. C. H. Weeks was in charge, assisted by Messrs. H. E. Troutman and A. H. Riddell. They also showed a model of their "Class B engine."

YALE & TOWNE MFG. Co. showed its various styles of hoists, both manually and electrically operated. Many visitors accepted the standing invitation to "pull the chain and see the load go up."

THE GARTON DANIELS Co. exhibit of its line of controller regulators for the automobileer attracted a great deal of attention and called forth considerable comment of a favorable character. The company also made a fine display of Garton lightning arresters. It was represented by Messrs. Garton, Titus and Cosper.

W. N. MATTHEWS & BRO. exhibited their well-known Stombaugh guy anchor and also their latest specialty, "The Kearney Cable Clamp." Mr. W. N. Matthews was kept busy explaining its merits.

AMERICAN STEEL & WIRE COMPANY, in addition to its wire samples, showed a line of track drills, rail bonds, etc.

WESTINGHOUSE EXHIBITS.—The exhibits of the Westinghouse Electric & Manufacturing Company and the Westinghouse Traction Brake Company at the American Street Railway Convention were notable for their feature of complete operative demonstration, and included a greater number of important new products than have been seen in Westinghouse displays for a considerable time. The natural interest shown in the exhibit of two types of Westinghouse single-phase railway motors—Nos. 107 and 108—with which a number of interurban lines in the South and West have been equipped in the past year, was enhanced on Wednesday upon the announcement of the order of the New York, New Haven & Hartford Railroad for 25 1,600-hp Westinghouse single-phase locomotives for use, at first over the New York Central's direct-current terminal system in New York, and, eventually, over long electrified sections of the New Haven's main lines. The various parts of the Westinghouse electro-pneumatic control for single-phase traction service were shown with the motors; and the Westinghouse multiple-unit control for direct-current railway service, with the latest type of rectangular switch group introduced in the equipment of the new cars of the Long Island Railroad, was shown in operation in a working arrangement of two No. 113 railway motors, each of 200 hp capacity; also of the type designed for the Long Island equipment. One of the most interesting features of the Westinghouse electrical exhibits was a 30,000-volt demonstration of the protection afforded by Westinghouse multi-path lightning arresters to either direct-current or alternating-current railway systems, through a complete installation of apparatus for the equivalent spark-gap tests which have been used in the development of the arresters. Souvenir sheets of paper showing the pure static discharge, the static discharge with line voltage impressed on the multi-path discharge block, and the static discharge and line current passing simultaneously over ordinary resistance were distributed during the demonstrations. The most important new traction brake equipment shown in the space of the Westinghouse Traction Brake Company was the type now in service on the Oak Square cars in Boston, automatic air application, with provision for straight-air release, for motor and trailer service. A new type of combination equipment for motor and trailer service was shown also in the SMA brake, straight-air, with an extra train line to provide for automatic brake application in emergencies, through the movement of the motorman's operating valve, or in the event of the separation of cars. Both equipments were shown in full operation, and the exhibits included also a rack arrangement of the standard combined automatic and straight-air Westinghouse brake for traction service, and different types of air compressors, valves, blowing outfits and sanders. Both the electrical and the brake exhibits were brilliantly lighted with Westinghouse 500-volt, direct-current arc lamps and with the incandescent globes of the Sawyer-Man Electric Company. Among the exhibits of the car-building companies were a car for the Long Island Railroad, equipped with Westinghouse motors and with the Westinghouse AMR traction brake, an automatic type, with provision for gradual release; and one of the 160 new Brill cars for Baltimore for which the Westinghouse traction brake is to be furnished. The Westinghouse reception headquarters in the Bellevue-Stratford blue room was well filled throughout the week, and Walter M. McFarland, acting vice-president of the Westinghouse Electric Company, was in almost constant attendance to act as host. Joseph R. Ellicott, eastern manager of the Westinghouse Traction Brake Company; F. M. Nellis, the New England representative, and Frederick V. Green, of the New York office, were prominent among those at the brake exhibits. Among the books and pamphlets given out by the Westinghouse Companies was a small map folder mentioning numerous Westinghouse engine and electrical installations in Philadelphia, and presenting in detail the figures of the leading part that has been played by the Westinghouse Companies in the equipment of the power houses and new sub-stations of the Philadelphia Rapid Transit Company.